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The Engineer

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MACHINE TOOL AND ENGINEERING EXHIBITION AT OLYMPIA (Third Notice).

The British Empire Exhibition (Twenty-second Notice).

A Diesel-Electric Locomotive.

Iron and Steel Institute.

Wire-Drawing and Wire-Working Machinery (No. IX.).

100 Years of British Railways—No. XII.

Institute of Metals.

PUBLIC NOTICES

Ministry of Transport.
CONSTRUCTION OF NORTH CIRCULAR ROAD (LEA VALLEY SECTION), ESSEX.

The Minister is prepared to receive TENDERS for the CONSTRUCTION of a REINFORCED CONCRETE VIADUCT with APPROACH ROADS, &c., across the Lea Valley, Essex.

Specification, bills of quantities, forms and conditions of Tender and contract, may be obtained from the Chief Engineer, Roads Department, Ministry of Transport, 7, Whitehall-gardens, S.W. 1, upon payment of a deposit of £25. This amount will be returned to the tenderer if his Tender is a bona fide one and has not been withdrawn prior to the definite acceptance of a Tender by the Minister.

The drawings may be inspected at the Ministry and copies of the forms and conditions of Tender and contract, specification, bills of quantities, will be available on and after Monday, the 22nd September, 1924.

Tenders, on the official form and accompanied by fully priced bills of quantities, must be submitted and enclosed in a sealed envelope, endorsed "Tender for Lea Valley Viaduct."

The Minister does not bind himself to accept the lowest or any Tender.

Tenders must reach the undersigned by 10 a.m. on the 10th day of October, 1924.

Dated this fifteenth day of September, 1924

(Esd.) H. H. PIGGOTT,
Assistant Secretary.

Ministry of Transport. 6926

The Director-General,
India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, REQUIRES :—
ROLLED STEEL JOISTS.

Tenders due on the 9th October, 1924.
Tender forms obtainable from above. 6970

Civil Engineers Required by the GOVERNMENT of the GOLD COAST for the PUBLIC WORKS DEPARTMENT for two tours of 12 to 18 months' service, with possible extension. Salary £480 for the first three years of service, then £510, rising to £720 a year by annual increments of £30, and then rising to £920 by annual increments of £40. Outfit allowance £60 on first appointment. Free quarters and passages and liberal leave at home on full salary. Candidates, age between 25 and 35, must be fully qualified Civil Engineers and have had practical and general experience on the Construction of Roads, Buildings and other public works.—Apply at once in writing, stating age and giving brief details of experience and qualifications, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, S.W. 1, quoting clearly at head of application M/12,885. 6956

Civil Engineers Required by the GOVERNMENT of CEYLON for appointment as IRRIGATION ENGINEERS for three years in the first instance. Salary £500, rising to £900 a year by annual increments of £40 (£800 on attaining 30 years of age). Free passage provided. Candidates, 26 to 31 years of age, unmarried, must have had war service and passed the examinations to qualify for Associate Membership of the Institution of Civil Engineers or hold equivalent professional qualifications, and have had at least three years' practical experience on Waterworks, Drainage, or Harbour and Dock Works.—Apply at once in writing, giving age and brief details of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting at head of application M/12,853. 6957

Civil Service Commission.
FORTHCOMING EXAMINATION: PROBATIONARY ASSISTANT ENGINEER in the Engineering Department of the General Post Office (20-22), with extension in certain cases), 9th October.

The date specified is the latest on which applications can be received. They must be made on forms to be obtained, with particulars, from the SECRETARY, Civil Service Commission, Burlington-gardens, London, W. 1. 6880

ENGINEERING AND TECHNICAL OPTICS.

Northampton Polytechnic Institute,
ST. JOHN-STREET, LONDON, E.C. 1.

ENGINEERING DAY COLLEGE.

Full-time Day Courses in the Theory and Practice of Civil, Mechanical, and Electrical Engineering. The Courses in Civil and Mechanical Engineering include specialisation in Automobile and AERONAUTICAL Engineering, and those in Electrical Engineering include specialisation in RADIO-TELEGRAPHY.

The ENTRANCE EXAMINATION will be held on TUESDAY and WEDNESDAY, 23rd and 24th SEPTEMBER. The Courses include periods spent in commercial workshops and extend over four years. They also prepare for the Degree of B.Sc. in Engineering at the University of London. Fees £18 and £13 per annum.

THREE ENTRANCE SCHOLARSHIPS of the value of £62 each for the complete course will be offered for competition at the Entrance Examination.

OPTICAL ENGINEERING AND TECHNICAL OPTICS.

Full and Part-time Courses in this important department of Applied Science are given in specially equipped laboratories and lecture rooms. The Annual Entrance Examination is held in September.

All day courses commence on Monday, 29th September.

EVENING TECHNICAL COURSES

in all branches of Mechanical and Electrical Engineering commence on Monday, September 22nd, 1924.

The Laboratories, both Mechanical and Electrical, are well equipped with modern apparatus, which, on the mechanical side, provides for specialisation in Automobile and Aeronautical Engineering and, on the electrical side, for specialisation in Alternate and Continuous-current Work, in Radio-telegraphy and Telephony, and in Electrical Testing.

More complete particulars, together with conditions of entrance, &c., and all information respecting the work of the Institute, can be obtained at the Institute or on application to

6521 S. C. LAWS, M.A., M.Sc., Principal.

PUBLIC NOTICES

The University of Sheffield.
SESSION 1924-25.

Vice-Chancellor: Sir HENRY HADOW, C.B.E., D. Mus., LL.D.

DEPARTMENTS OF MECHANICAL, ELECTRICAL, AND CIVIL ENGINEERING, METALLURGY, MINING, FUEL TECHNOLOGY, AND GLASS TECHNOLOGY.

The Courses in the above Departments extend over three or four years and prepare students to become specialists in one or other of these branches of Applied Science.

The LECTURE COURSES in all the Departments are supplemented by Practical Training in Laboratories and Workshops, which are fully equipped for the purpose of advanced scientific teaching, investigation and research.

Part-time Courses are arranged for students who desire to take special portions of any of the regular courses.

In Mining Engineering and in certain of the Courses in Mechanical and Electrical Engineering, and in Glass Technology, arrangements are made to enable students who come to the University from works or collieries to take six months' courses of study at the University and six months' practice at the works or colliery each year for a period of four years.

The LECTURE COURSES commence OCTOBER 1st, 1924.

The TECHNICAL LABORATORY COURSES commence SEPTEMBER 23rd, 1924.

For further details of the Courses and for particulars of the Degrees, Associateships, Diplomas, and Certificates awarded on their successful completion, application should be made to

W. M. GIBBONS,
6712 Registrar.

Loughborough College,
LEICESTERSHIRE.

WANTED, a WORKING INSTRUCTOR for CENTRE LATHE SHOP. Applicants should have a good all-round knowledge of Machine Shop practice.

Also a WORKING INSTRUCTOR is REQUIRED for VEHICLE BUILDING, TRIMMING and PAINTING. Applicants must be able to undertake and give instruction in any of these processes.

It is regarded as essential that candidates for the above posts shall be of good education and have passed the London Matriculation or similar examination.

Applications, which should be in writing and addressed to the PRINCIPAL, should state age and salary required, with copies of testimonials. 6922

Bombay, Baroda, and Central India Railway Company.

The Directors are prepared to receive up to Noon on Friday, 26th September, 1924, TENDERS for the SUPPLY of :—

1. RED LEAD.
2. STEEL MATERIAL (CHANNELS, ANGLES, PLATES AND BARS).

Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of 10s. each for No. 1 and 20s. each for No. 2 (which will not be returned).

The Directors do not bind themselves to accept the lowest or any Tender.

S. G. S. YOUNG,
Secretary.

Offices: The White Mansion, 91, Petty France, Westminster, S.W. 1, 12th September, 1924. 6925

PUBLIC NOTICES

University of the Witwatersrand, Johannesburg.

CHAIR OF ELECTROTECHNICS.

APPLICATIONS are INVITED for the CHAIR of ELECTROTECHNICS, vacant through the retirement, under superannuation, of Professor H. J. S. Heather.

SALARY.—£1000 per annum, rising by annual increments of £50 to £1100.

TRANSPORT.—Allowance of £60 towards passage expenses together with free 1st class ticket from Cape Town to Johannesburg. Half salary during voyage.

CONDITIONS.—The appointment is full-time and subject to the regulations of the University. Duty is to be assumed on 1st March, 1925.

Applications, with copies of testimonials, all in quintuplicate, should be lodged with the SECRETARY, Office of the High Commissioner for the Union of South Africa, Trafalgar-square, W.C. 2 (from whom further particulars and forms of application may be obtained), not later than 30th September, 1924. 6860

Bengal-Nagpur Railway Company, Limited.

The Directors are prepared to receive TENDERS for :—

(a) SPRING STEEL.
(b) MILD STEEL PLATES AND SHEETS.
(c) M.S. ANGLES, CHANNELS AND BARS.
(d) BEST YORKSHIRE AND GRADE "A" IRON.
(e) GIRDER BRIDGES.

Specifications and forms of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, E.C. 2, on or after 15th September, 1924.

A fee of 20s. will be charged for each specification, which is not returnable.

Tenders must be submitted not later than Noon on Saturday, 27th September, 1924.

The Directors do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right of reducing or dividing the orders.

By Order of the Board,
R. C. VOLKERS,
6930 Secretary.

Bengal-Nagpur Railway Company, Limited.

The Directors are prepared to receive TENDERS for :—

(a) 2 GOODS ENGINES and TENDERS, 2ft. 6in. gauge.
(b) 6000 STEEL BOILER TUBES.
(c) 18 COPPER FIREBOX TUBE PLATES.

Specifications and forms of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, E.C.2, on or after 19th September, 1924.

A fee of 20s. will be charged for each specification, which is not returnable.

Tenders must be submitted not later than Noon on Thursday, 2nd October, 1924.

The Directors do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right of reducing or dividing the orders.

By order of the Board,
R. C. VOLKERS,
6971 Secretary

PUBLIC NOTICES

Caledonian Collieries, Limited.
NEWCASTLE, NEW SOUTH WALES, AUSTRALIA.

TENDERS are hereby INVITED for the SUPPLY DELIVERY and ERECTION on site of :—

TURBO-ALTERNATORS,
CONDENSERS, PUMPS,
BOILERS, PIPE WORK,
SUPERHEATERS, CHIMNEY,
FANS, SWITCHBOARDS,
TRANSFORMERS, &c.

Specification can be obtained from Howard Smith, Limited, 33, Cornhill, London, E.C. 3, on deposit of £1 1s., which will be returned on receipt of bona fide Tender. Additional copies, 5s. each, which charge will not be returned.

Tenders, endorsed "Electric Power Plant," and addressed to HOWARD SMITH, Limited, Managing Agents, Caledonian Collieries, Limited, 33/45, Market-street, Melbourne, Australia, must be delivered before 5 p.m., 25th November, 1924. 6952

County Borough of Eastbourne.
BOROUGH ENGINEER'S AND SURVEYOR'S DEPARTMENT.

TENDERS are INVITED for the REMOVAL of existing TIDAL FLAPS, &c., in the Valve Chamber, Langney Point, and the SUPPLY and FIXING of NEW TIDAL and SLUICE VALVES.

Plans, specification, and form of Tender may be obtained from and general conditions of contract seen at the Borough Engineer's Office, Town Hall, Eastbourne, on and after the 22nd of September, on payment of a deposit of One Guinea, which will be refunded on receipt of a bona fide Tender and the return of the plans.

Sealed Tender, endorsed "Valves, Langney Point," to be delivered at the Borough Engineer's Office not later than the first post, 14th October, 1924.

The Corporation do not bind themselves to accept the lowest or any Tender.

LESLIE ROSEVEARE, M. Inst. C.E.,
Borough Engineer.

The Town Hall, Eastbourne, September, 1924. 6937

Metropolitan Asylums Board.

The Board invite TENDERS for the DRY-DOCKING and REPAIR of the HULL and FITTINGS of the RIVER AMBULANCE STEAMER "MALTESE CROSS," in accordance with specification prepared by Mr. T. Cooper, M.I.C.E., M.I.M.E., Engineer-in-Chief to the Board.

Specification, conditions of contract, and form of Tender may be obtained at the Office of the Board, Victoria Embankment, London, E.C. 4.

Tenders, addressed as noted on the form, must be delivered at the Office of the Board not later than 10 a.m. on Wednesday, 8th October, 1924.

G. A. POWELL,
6927 Clerk to the Board.

Siam State Railways.
NOTICE.

TENDERS are INVITED for the SUPPLY of ACCESSORIES for GOODS ROLLING STOCK B.E. 2467," must be forwarded to the Commissioner-General of the Siam State Railways, at whose office in Bangkok, Siam, they will be received up to Fourteen o'clock on the 31st December, 1924, at which place and hour the Tenders will be publicly opened and read.

Right is reserved to reject any or all Tenders and to accept any Tender which in the opinion of the Administration is to the best interests of the Siam State Railways.

(Sgd.) ACTING COMMISSIONER-GENERAL.
Department of State Railways,
Bangkok, 13th August, 1924. 6931

Tyne Improvement Commission.
CARPENTERS' AND BOATBUILDERS' SHEDS.

The Tyne Improvement Commissioners are prepared to receive TENDERS for the CONSTRUCTION and MAINTENANCE of a STEEL SHED erected complete at their Engineering Yard, Howdon-on-Tyne.

Copies of the form of Tender, conditions of contract, specification and drawing may be obtained on application to the undersigned on payment of a deposit of £3 3s., which will be returned on receipt of a bona fide Tender.

Tenders, in sealed envelopes, endorsed on the cover "Tender for Carpenters' and Boatbuilders' Sheds," must be addressed to "The Chairman, Dredging and River Works Committee" and delivered at the undermentioned offices not later than Noon on Wednesday, the 1st day of October, 1924.

The Commissioners do not bind themselves to accept the lowest or any Tender.

By Order,
ALBERT BLACKLOCK,
Secretary.

Tyne Improvement Commission Offices, Bewick-street, Newcastle-upon-Tyne, 16th September, 1924. 6939

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PUBLIC NOTICES

London and North-Eastern
RAILWAY.

The Directors are prepared to receive TENDERS for the RECONSTRUCTION of NORTH SEATON VIADUCT over the River Wansbeck near North Seaton Station, on the Company's Newbiggin Branch.

The contract is for a new double line steel structure, 1041ft. 9in. between the abutments, and comprises excavation and piling in foundations of abutments and piers; masonry, concrete and brickwork in abutments and piers; the supply and erection of steel work in trestles, main and parapet girders, decking, &c. (approximately 1750 tons); also the removal of the existing timber viaduct, the Tender to include an offer to purchase the materials of the same.

Drawings may be seen and specification, detailed quantities and form of Tender obtained on personal application only at the office of the Chief Engineer, North-Eastern Area, at York, on Wednesday, October 1st. Tenders, marked "Tender for the Reconstruction of North Seaton Viaduct," must be received by Joint Secretaries, London and North-Eastern Railway, Marylebone Station, London, N.W.1, by 9 a.m. on Wednesday, 15th October.

The Directors do not bind themselves to accept the lowest or any Tender.

JAMES McLAREN,
G. F. THURSTON,
Joint Secretaries.

Secretary's Office,
Marylebone Station.
9th September, 1924. 6916

London and North-Eastern
RAILWAY.

The Directors are prepared to receive TENDERS for the CONSTRUCTION of a CONCRETE CULVERT and the DIVERSION of the SLEEKBURN under Sleekburn Viaduct near Bedlington Station, on the Company's Newbiggin Branch.

The contract comprises amongst other work about 400 c. yds. of excavation in diversion of the stream and concrete work totalling about 1800 c. yds.

Drawings may be seen and specification, detailed quantities and form of Tender obtained on personal application only at the office of the Chief Engineer, North-Eastern Area, at York, on Wednesday, October 1st. Tenders, marked "Tender for the Construction of Concrete Culvert at Sleekburn," must be received by the Joint Secretaries, London and North-Eastern Railway, Marylebone Station, London, N.W.1, by 9 a.m. on Wednesday, 15th October.

The Directors do not bind themselves to accept the lowest or any Tender.

JAMES McLAREN,
G. F. THURSTON,
Joint Secretaries.

Secretary's Office,
Marylebone Station.
9th September, 1924. 6917

State Electricity Commission
OF VICTORIA.
MELBOURNE, VICTORIA, AUSTRALIA.

TENDERS are hereby INVITED for the SUPPLY, DELIVERY, &c., of the following for the Yallourn Power Scheme.

Copies of Tender form and specification will be available upon application to:—
Agent-General for Victoria,
Melbourne-place, Strand,
London, W.C. 2.

SPECIFICATION NO. 24/90.—22,000-VOLT CABLE AND ACCESSORIES.

CHARGE.—£1 for the first three copies of Tender form, conditions of contract and specification complete. This charge will be returned on receipt of a bona fide Tender. A fourth copy and any further copies will be supplied for the sum of 10s. each. This charge is not returnable.

PRELIMINARY DEPOSIT.—A preliminary deposit of £166 is to be lodged with Tender.

The specifications may be inspected at the above-mentioned office.

The Commission does not bind itself to accept the lowest or any Tender.

Tenders, on prescribed form, properly endorsed and addressed, must be delivered to the undersigned in Melbourne not later than 5 p.m., 24th November, 1924.

R. LIDDELOW,
Secretary.

6863

The Bengal and North-Western
RAILWAY COMPANY, LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of:—
(a) RED AND WHITE LEAD;
(b) METALS;
as per specification to be seen at the Company's Offices.

Tenders, addressed to the undersigned and marked "Tender for Red and White Lead," or as the case may be, with name of firm tendering, to be lodged not later than Noon on the 3rd day of October, 1924.

For each specification a fee of 10s. will be charged, which cannot under any circumstances be returned.

The Directors do not bind themselves to accept the lowest or any Tender.

By Order of the Board,
E. A. NEVILLE,
Managing Director.

237, Gresham House, Old Broad-street,
London, E.C. 2, 13th September, 1924. 6929

The Madras and Southern
MAHRATTA RAILWAY COMPANY, LTD.

The Directors are prepared to receive TENDERS for

METRE GAUGE
- 14 FOUR-WHEELED COVERED GOODS WAGONS (I.R.C.A. STANDARD TYPE M.A.1.) (without Wheels and Axles).
- 188 FOUR-WHEELED OPEN GOODS WAGONS (I.R.C.A. STANDARD TYPE M.C.1) (without Wheels and Axles),

in accordance with the specification, which may be seen at the offices of the Company. The charge for the specification is One Guinea, which will not be returned. Tenders must be sent in, addressed to the SECRETARY, not later than 2 p.m. on Tuesday, the 7th October, 1924, and marked "Tender for Wagons."

The Directors do not bind themselves to accept the lowest or any Tender.

Company's Offices:—
25, Buckingham Palace-road, Westminster, S.W.1,
16th September, 1924. 6960

SITUATIONS OPEN

WANTED, GENERAL MANAGER, Sale and Erection Gas Plants; first-class commercial experience and ability essential; four-figure salary.—Write, "E. F.," c.o. Charles Barker and Sons, Ltd., 31, Budge-row, E.C. 4. 6965 A

WANTED, to REPRESENT British FIRM in India, fully qualified ENGINEER of good education and address. Preferably with knowledge of Ball and Roller Bearing applications and experience of salesmanship. Single man preferred.—Write, stating salary required, Box M395, Willings, 30, King-street, Covent Garden, W.C. 2. 6848 A

ASSISTANT BUYER WANTED by Large General Engineering Firm. Must be fully acquainted with modern methods of card index control and capable of obtaining deliveries to time. Under 35 years of age preferred. State full details of experience, age, and salary required.—Address, 6944, The Engineer Office. 6944 A

LIME WORKS MANAGER and SALESMAN WANTED, age 27 to 40; must have a good knowledge of Lime Burning and Hydrating, and some knowledge of Chemistry.—State salary and full particulars of past experience, to "LIME MANAGER," HALL and CO., Ltd., Victoria Wharf, Croydon. 6958 A

THE STANTON IRONWORKS COMPANY, Limited, near Nottingham, REQUIRE the SERVICES of an experienced METALLURGIST used to Cupola and Gas Producer practice.—Apply in writing, giving full particulars and present salary, to the above, addressed "Foundry General Manager." 6932 A

LONDON COUNTY COUNCIL.

ENGINEERING

(AERONAUTICAL, CIVIL, ELECTRICAL, GAS, MARINE, MECHANICAL, MOTOR CAR, AND STRUCTURAL).

DAY AND EVENING CLASSES.

Battersea Polytechnic, Battersea Park Road, S.W. 11.	Full-time Day Courses in Mechanical Engineering Civil and Constructional Engineering, and Electrical Engineering. Evening Classes in Mechanical, Civil, and Electrical Engineering. Trade Classes (including Classes for Motor Drivers)
Borough Polytechnic, Borough Road, S.E. 1.	Day Technical School for Boys intending to enter the Engineering Trades. Evening Classes in Mechanical Engineering (including Motor Car Engineering), Electrical Engineering. Trade Classes.
Goldsmiths' College, New Cross, S.E. 14.	Evening Classes in Electrical, Mechanical, and Constructional Engineering. Trade Classes
Hackney Institute, Dalston Lane, E. 8	Day Technical School of Engineering. Evening Classes in Electrical, Mechanical, Motor Car, and Structural Engineering.
Northampton Polytechnic, St. John Street, Clerkenwell, E.C. 1.	Civil, Mechanical (including Aeronautical), and Electrical Engineering. Full-time Day School and Evening Classes. Day and Evening Courses in Optical Engineering, and Part-time Courses for Apprentices in the Electrical Trades.
Paddington Technical Institute, Saltram Crescent, W. 9.	Day Technical School of Engineering. Evening Classes in Electrical and Mechanical Engineering.
Regent Street Polytechnic, Regent Street, W. 1.	Civil, Electrical, Motor Car, and Mechanical Engineering. Day School and Evening Classes. Evening Classes in Aeronautical and Gas Engineering.
School of Engineering and Navigation, High Street, Poplar, E. 14.	Day Technical School of Engineering, with Department in Marine Engineering. Evening Classes in Electrical, Marine, and Mechanical Engineering.
Wandsworth Technical Institute, High Street, Wandsworth, S.W. 18.	Evening Classes in Mechanical Engineering.
Westminster Technical Institute, Vincent Square, S.W. 1.	Evening Classes in Civil and Gas Engineering.
Woolwich Polytechnic, William Street, Woolwich, S.E. 18.	Day School for Boys intending to enter the Engineering Trades. Part-time Day Courses for Engineer and Trade Apprentices. Evening Classes in Mechanical, Structural, and Electrical Engineering. Special Lectures in Motor Engineering Trade Classes.

Full particulars as to fees, &c., may be obtained on application at the various Institutions.
Evening Classes open 15th September, 1924.

JAMES BIRD,
Clerk of the London County Council.

SITUATIONS OPEN (continued)

THE PHŒNIX 'OIL and TRANSPORT CO., Ltd., operating in Roumania, has VACANCIES for a number of GRADUATES in the FACULTY of ENGINEERING, Civil or Mechanical.

Particulars can be obtained from Company's Offices, 6, Princes-street, Bank, London, E.C. 2. 6931 A

WANTED IMMEDIATELY, DRAUGHTSMAN, with experience in Design of Large Valves and Sluice Gates for irrigation work, &c.—Address, stating salary and giving full particulars, 6948 The Engineer Office. 6948 A

DESIGNER WANTED, with Experience in Aeroplane Engines.—Address, stating age, experience and salary required, 6964, The Engineer Office. 6964 A

DRAUGHTSMAN REQUIRED, London District, Elevating and Conveying Plants experience. State age and salary required.—Address, 6945, The Engineer Office. 6945 A

DRAUGHTSMAN, Steam and Electric Cranes, Aged 22-28. State experience and salary required.—Address, 6868, The Engineer Office. 6868 A

DRAUGHTSMAN.—TWO WANTED by Important Firm of Marine Engineers manufacturing Diesel Engines on North-East Coast. Must be quick, reliable, and capable of checking drawings. State full particulars of experience, age, and salary required, and send copies of testimonials.—Address, 6936, The Engineer Office. 6936 A

FIRST-CLASS DRAUGHTSMAN REQUIRED for Aeroplane and Seaplane Work.—Write, stating complete details and salary required, to the BLACKBURN AEROPLANE and MOTOR CO., Ltd., Brough, East Yorks. 6867 A

FIRST-CLASS STRUCTURAL DRAUGHTSMAN WANTED for works near Birmingham, experienced in Designing and Detailing Steel Structures of all descriptions. State age, experience and salary required.—Address, 6949, The Engineer Office. 6949 A

FIRST-CLASS STRUCTURAL DRAUGHTSMEN REQUIRED, for North-East Coast. Must have had experience on Heavy Bridge Work, Foundations, Buildings, &c.; designing, preparing drawings for shops and estimating. State salary required. Others need not apply.—Address, 6906, The Engineer Office. 6906 A

FIRST-CLASS STRUCTURAL DRAUGHTSMEN REQUIRED; none but experienced men need apply. State full particulars, age, salary required.—THE CLEVELAND BRIDGE and ENGINEERING CO., Ltd., Darlington. 6799 A

INDIA.—REQUIRED for Large Works, Thoroughly capable RAILWAY WAGON DRAUGHTSMAN; young unmarried man; 5 years' agreement.—Write, stating age, with full particulars of training and experience, to Z.A. 504, c.o. Deacon's Advertisement Agency, Leadenhall-street, London, E.C. 3. 6954 A

LEADING DRAUGHTSMAN WANTED in Midlands, used to Structural Work and Steam Plant.—Address, stating age, experience, and salary required, 6941, The Engineer Office. 6941 A

SITUATIONS WANTED

A 1. ENGINEER DESIRES CHANGE. Naval architectural degree; head draughtsman; five years' premium pupilship, world's outstanding engineering firm, including one year's specialised intimate, practical, marine engine experience.—Address, P9588, The Engineer Office. P9588 B

SITUATIONS WANTED (continued)

A.D. MAN, 16 Years Large Advtg. Agency (all depts.) WANTS POST, Assistant Advt. Manager Engineering Firm, London.—Address, P9598, The Engineer Office. P9598 B

A.M.I.C.E. (32), on Leave from Far East, DESIRES CHANGE; thoroughly experienced in designing, estimating and carrying out all classes of building construction and reinforced concrete work, &c.; used to controlling staff, and handling large contracts; last 8½ years manager; competent to represent a firm of good standing abroad.—Address, P9592, The Engineer Office. P9592 B

B.Sc. (Eng.) (21), One Year Mech. Works, SEEKS progressive POST, Junior Assistant to Contractor or A.M.I.C.E. Knowledge field surveying.—Address, P9581, The Engineer Office. P9581 B

BUYER, STOREKEEPER or Other Position of Trust; experienced iron and steel.—E. M., 22, Victoria-mansions, Grange-road, Wimbledon, S.W. 19. P9590 B

CHARTERED CIVIL ENGINEER, University degree, ex-Major R.E., age 35, wide experience railway construction, roads, drainage, housing, management, SEEKS POST with Consulting Engineer or Contractors with VIEW to PARTNERSHIP.—Address, P9594, The Engineer Office. P9594 B

ENGINEER DRAUGHTSMAN (32), Mech., Civil, elec., chemical, and bdg. construction exp., DESIRES POST, any capacity, inside or out.—Address, P9579, The Engineer Office. P9579 B

ENGINEER, Marine and Shop Experience, First B.O.T. Certificate, SEEKS SITUATION, charge, maintenance, or progressive position, home or abroad.—Address, P9583, The Engineer Office. P9583 B

ENGINEER, Mechanical and Marine, Age 32, B.O.T. Cert., 5 yrs. O.E.M.S., 10 yrs. exp. all classes engines and boilers, urgently DESIRES progressive SHORE POST, at home or abroad.—Address, P9580, The Engineer Office. P9580 B

ENGINEER (31), Private Estate or Institution, mechanical, electric light, erect and maintenance, good fitter, turner, sound knowledge engines, boilers, pumps, crude oil engines, and steam, &c.—Address, P9577, The Engineer Office. P9577 B

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For continuation of Small Advertisements see page 3.

A Seven-Day Journal

The Japanese Earthquake.

PRACTICALLY on the anniversary of the day, in September, 1923, when Tokyo and Yokohama were devastated by the great earthquake, there arrived in this country the first official Japanese report on the occurrence. It is written by Professor A. Imamura, and deals with the seismic side of the subject. Other reports concerned with the earthquake as viewed from the standpoints of geology, meteorology, architecture, civil engineering, &c., are being prepared, and it is expected that they will all be ready within a few months. In his report Professor Imamura describes the actual shock, and is able to give considerable detail, as he happened to be in his seismological laboratory at the time. He goes on to say that after the shock he measured the displacement of some of the buildings in the most disturbed area, and found movements of from 30in. to 36in., while one house had shifted 51in. The centre of the earthquake was 57 miles from Tokyo in the centre of Sagami Bay where, over an area of 270 square miles, the bottom of the sea has been depressed on an average by 39 fathoms. On the other hand, however, an area of some 90 square miles has risen, on the average, 45 fathoms. It is stated that as many as 128,266 houses collapsed completely as a result of the earthquake, while 126,233 partially collapsed. The percentage of collapsed buildings to those left standing varied greatly in different localities, and ranged from 12¼ per cent. in Yokohama to 84½ per cent. at Kamakura.

Belgian Trade.

THE refusal of Belgium to accept the commercial arrangement proposed by the French Government last year will have a serious effect upon trade with France if the Belgian Parliament should vote the new fiscal Bill, which will impose heavy duties on foreign goods. So long as the French duties keep out Belgian goods, while the products from France enter much more freely into Belgium, it is evident that there can be little hope of the Belgian Government agreeing to continue the present policy for an indefinite period until some suitable arrangement can be come to between the two countries. The value of Belgian goods sent to France is only one-third the value of the French exports to Belgium. As they consider that they are being unfairly treated by their French friends, with whom they had hoped to develop business relations, the Belgians are looking elsewhere for an extension of trade. The forthcoming treaty with Germany may possibly introduce an unsatisfactory element into the situation so far as the French are concerned, and now there is a strong tendency in Belgium towards encouraging closer relations with Great Britain. As Great Britain is at present exporting to Belgium less than one half the value of the Belgian exports to this country, the idea of obtaining facilities for increasing that trade is becoming a prominent factor in commercial politics. It may be questioned whether British manufacturers would gain much from a treaty that offers them special advantages until the exchange rate is more favourable to business transactions, but the Belgian attitude in abandoning completely any attempt to come to an arrangement with France, and in turning to Great Britain and even to Germany as the only means of recovering industrial activity, is causing some concern to French producers.

The Electricity Commissioners' Report.

A SPECIAL feature of the fourth annual report of the Electricity Commissioners is a table giving an approximate indication of the extent and population of the local government areas in England and Wales. It shows that nearly 80 per cent. of the population is concentrated in areas aggregating 6507 square miles, representing about 11 per cent. of the total area of England and Wales, the average density of population throughout such portions of the country being 4615 per square mile. About 20 per cent. of the population is sparsely distributed over the vast area comprised in rural districts, representing about 89 per cent. of the total area of the country, and having an average density of population amounting to 151 per square mile, or less than one-thirtieth of that of the remainder of England and Wales. These figures, the report states, afford a clear indication of the governing factor in the problem of establishing remunerative supplies of electricity in rural districts of an average character.

New Mining Regulations.

THE new regulations issued by the Secretary for Mines, which come into operation on October 1st, aim at providing additional safeguards against gas and dust dangers. It is specified that no one may then be appointed to fire shots unless he possesses the necessary qualifications as regards age and experience, while his wages must not depend on the amount of mineral won. The examination for gas, which has to be made immediately prior to the firing of any shot is to be extended to a radius of 20 yards from the shot hole, and shot firing is prohibited within a similar area around cavities and breaks, which are not accessible for examination for gas contained in, or issuing from, them. Every place where a shot is to be fired must be thoroughly treated with stone dust, or water, unless the shot firer has written permission from the manager, or under-manager, under specific conditions, to dispense with this precaution. The regulations also stipulate that in the event of two shot holes being so close together that the firing of one shot may relieve the work to be done by the other, the second hole must not be charged until the first shot has been fired. The object of this rule is, of course, to prevent the second hole being overcharged. A limited exception is, however, made in the case of shots used in bringing down coal in long-wall faces, if the shots are fired between shifts.

The London County Council Tramways.

IN a memorandum incorporated in the annual report of the London County Council which was issued on Monday last, Mr. A. L. C. Fell, the general manager of the Council's tramway undertaking, makes reference to the adverse effect of the competing omnibus traffic. It is estimated that during the year there has been an increase in the number of omnibuses plying on the Council's tramway routes of about 40 per cent., and this figure does not include the tramway routes of outside authorities over which the London County Council has running powers. In his report Mr. Fell states that the rivalry of competing omnibus owners has resulted in the congestion of many routes by a number of vehicles which is far in excess of the requirements of the public. The continual operation of these surplus conveyances has had a serious effect on the revenue of the Council's tramway undertaking, apart from the obstruction to tramway and other traffic. In a Journal paragraph which appeared in our issue of July 4th, we gave some figures of the working costs for the London County Council's tramways for the year ended March 31st last. It was shown that a loss of £160,222 7s. 5d. had been made, which was made good from the Reserve Fund, while the estimated loss on this year's working is expected to be about £316,276. The number of persons carried last year numbered about 689,000,000, compared with 734,000,000 in the previous year. Commenting on the reduction in fares during the last two or three years, Mr. Fell states that, although such reductions were not followed by an increase in revenue, it was reasonable to assume that the decline in revenue would have been still greater had not the cuts been made.

The Liner Statendam.

THE Holland-America liner Statendam, which was successfully launched from the East Yard of Harland and Wolff, Limited, at Belfast, on Thursday last, is not only the largest vessel to be launched from a British shipyard since the war, but she is also the biggest ship which is at present under construction. The Statendam was ordered a little over two years ago, but work on her was delayed by the rapid increase of shipbuilding costs. It is now intended to berth her alongside the builders' deep water wharf, to be completed as and when required by her owners. The new liner has an overall length of 697ft., with a breadth of 81ft. and a depth of 53ft. 6in. Her accommodation is designed to provide for about 3000 passengers, and she will have a tonnage of about 30,000 gross. Twin single-reduction geared turbines of the Brown-Curtis type are to be installed, and the auxiliary electrical machinery, both for engine-room and deck use, will be one of the largest electrical installations aboard ship. The hull has eleven water-tight bulkheads, dividing the vessel into twelve compartments, while the double bottom of the ship, which is extended right fore and aft, is arranged for carrying oil fuel, or water ballast, fresh water being carried in six sections.

A New Fishery Patrol Boat.

THE motor-driven hydroplane Vaila, which underwent successful handing-over trials on the Clyde a few days ago, represents a new type of craft which has been specially designed for the patrol service of the Scottish Fisheries Board. The vessel was built by Hugh M'Lean and Sons, of Govan, to the designs of Norman Hart, of London, and her propelling machinery was supplied by Gleniffer Motors, Limited, of Anniesland, Glasgow. Accommodation is provided in her for two officers and a crew of three, and the specification calls for a speed of not less than 16 knots, with a cruising radius of about 400 miles. The hull is of the stepless hydroplane type, with a keel the full length of the vessel, and the main dimensions of the hull are as follows:—Overall length, 55ft.; breadth, 12ft., and depth, 6ft. 6in. With a displacement of approximately 14 tons, the Vaila may be claimed to be the largest stepless hydroplane which has yet been built in this country. Three Gleniffer six-cylinder engines of 6in. bore and 8in. stroke are installed, and each unit is designed for an output of from 75 to 90 brake horse-power. The centre engine is constructed to burn paraffin, and is used for manœuvring and when cruising, a speed of about 8 knots being obtained with the moderate consumption of half a gallon of fuel per nautical mile. The wing engines are petrol motors, fitted with friction clutches, and are employed when additional propelling power is required. They raise the speed of the vessel to 16 knots. During the basin trials the engines developed, we are informed, more than their rated power, while on the speed trials over the Skelmorlie mile, the guaranteed speed of 16 knots was easily obtained in a choppy sea.

South African Railways.

A MEMORANDUM issued by the general manager of the South African Railways contains some interesting information concerning the proposed electrification scheme for the Cape Peninsular Railways. The whole of the Cape Town–Simon's Town line is to be electrically equipped. The docks, passenger service, and the Sea Point line, are also to be worked electrically, but during the current financial year only the preliminary work is being undertaken. Work on a large scale will not be possible until the Electricity Supply Commission, which is erecting a super-power station, is ready to carry out its share of the undertaking. During the financial year 1924–1925 a sum of £25,000 will be spent on the construction of electric motor coaches, and £10,000 will be devoted to work on the track and to the conversion of existing coaches into electric coaches. It is anticipated that in the early months of the next financial year work will be undertaken on a large scale, and that at the end of 2½ years the scheme will be completed.

The Mauretania at Plymouth.

ANOTHER Transatlantic record was made by the Cunard liner Mauretania on Monday last, when she called at Plymouth instead of proceeding direct to Cherbourg and then to Southampton. The crossing from New York to Plymouth was completed in the remarkable time of 4 days 21 hours and 57 minutes. One of the fastest rivals of the Mauretania, the French liner Paris, although she left New York at the same time, did not reach Plymouth until noon on Tuesday. The Mauretania was welcomed on her arrival by the Mayor of Plymouth and by members of the Chamber of Commerce and other associations. The Mayor expressed the hope that the call at Plymouth might become permanent in view of its considerable commercial advantages. The Great Western Railway was well prepared to co-operate in the rapid dispatch of passenger and mail traffic to London, and some 1200 bags of mails from America were landed at Plymouth by the Mauretania, and were delivered at Paddington at 10.28 p.m. the same evening. The total distance of about 227 miles from Plymouth to Paddington was covered in a non-stop run of 243 minutes, or in 3 minutes over four hours.

British Enterprise in Spain.

CONSIDERABLE importance attaches to the award to a British syndicate of the contract for the construction of a strategic railway to be built from Santander to Calatayad *viâ* Burgos and Soria. The tender accepted is that of a group representing British capital on whose behalf Sir Lionel Phillips has personally been conducting negotiations. The new line, which will provide direct through communication between Santander and Valencia, that is between Atlantic and Mediterranean ports, is expected to lead to the development of districts of considerable potential value. The concession granted provides for a guarantee by the Spanish Government of interest at the rate of 5 per cent. on a capital of about 348,000,000 pesetas for a period of ninety-nine years. It is understood that an English company will be formed under the auspices of the Central Mining and Investment Corporation, and Messrs. Bernard Scholle and Co. to carry out the construction of the line. Apart from the opening afforded by the concession for the profitable employment of British capital, it is hoped that British trade will successfully compete for a fair share of all equipment which Spain may be unable, or be in a less favourable position, to supply.

Broadcasting at Sea.

BEFORE any wireless apparatus can be installed or worked on a British ship, it is necessary, under the Wireless Telegraphy Act of 1904, to obtain permission from the Postmaster-General. Hitherto, the wireless apparatus on ships has been used almost entirely for the reception and transmission of Morse signals, but since the advent of broadcasting, there has been a desire to pick up the transmissions of the broadcasting stations. Licences to use wireless apparatus for that purpose are now being issued, and any shipowner desiring such a licence should apply to the Secretary, the General Post Office, E.C. 1. In the case of ships equipped with commercial installations, special conditions are imposed in addition to those issued with the new licence. Except when the ship is in port, the main aerial must not be used for the reception of broadcast programmes. Moreover, the broadcast receiving apparatus must not be connected in any way with the main wireless installation. The use of the broadcast receiving apparatus by the wireless operator is prohibited during the time he is on duty, and if he experiences any interference from the ship's broadcast receiver, he must report the fact to the captain.

The British Empire Exhibition.

ENGINEERING EXHIBITS, No. XXII.*

RAILWAY TRACK, SIGNALLING AND SAFETY APPLIANCES.

ENGINEERS and operating officers of railways about to be converted to electric traction, or whose area of electrification is to be extended, will be interested in what the Vacuum Brake Company, Limited, of Westminster, has to show. It is made evident by the exhibits that ordinary coaching stock, as used on steam-worked trains, equipped with the vacuum brake, need not be scrapped, but can continue to be used when the trains are electrically operated. The motor coach, with multiple-unit trains, can of course be provided with an exhauster driven by an electric motor, and therewith the vacuum brake can be operated just as on a steam-worked train. Exactly the same thing can be done with vacuum-fitted freight stock drawn by electric locomotives.

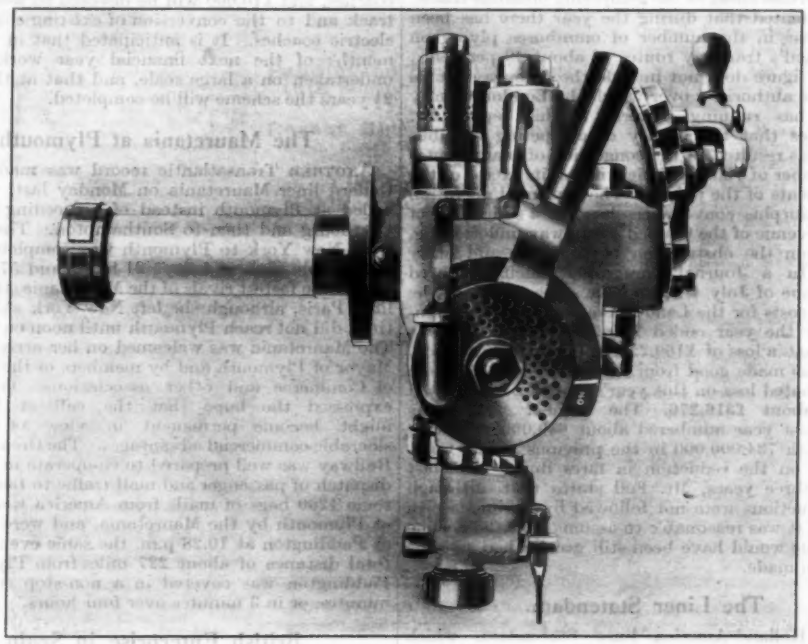


FIG. 425—EJECTOR FOR VACUUM BRAKE—GRESHAM AND CRAVEN

An emergency valve is provided for the automatic application of the brake, which is in connection with, and operates with, the "dead man's handle" or an automatic train stop, should either or both be used. The electric motor and exhauster are placed in a case within the framework of the electric locomotive or the motor coach, and the vacuum equipment is the same as on an ordinary coach. The only essential difference as far as the driver is concerned is the combined brake valve for controlling the brake and motor exhauster.

At the adjoining exhibit of Gresham and Craven, Limited, of Manchester, is shown the Super-Dreadnought ejector made by that firm for the vacuum brake, and illustrated herewith—Fig. 425. It has three sets of cones—two 15 mm. for the small ejector and one 30 mm. for the large. For trains with short-coupled stock and for those used in suburban services, the opening of one small cone is sufficient, and the ejector is so built that only one small cone is opened when the handle is turned, saving 140 lb. of steam per hour thereby, when compared with the standard 20 mm. to 30 mm. Dreadnought. When conditions call for the second cone to be opened, a catch is drawn forward, permitting further movement of the handle, so that the second small cone is opened. The air-lock ball has been supplemented by a valve, operated mechanically off the small ejector handle, which gives a positive opening. Further particulars of this ejector which is supplied through the Vacuum Brake Company, Ltd., may be found in our issue of September 5th, page 276.

FIG. 426—KEY-TOKEN APPARATUS—TYER

Gresham and Craven, Limited, also show a reversible injector—now being extensively used in India—for attachment to either side of the footplate, and to serve either right hand or left hand. A blank flange is placed over that one of the two delivery branches which is not required. The overflow, and water branches, being separate units bolted on can be fixed to suit whichever side they are placed on. The same firm shows a complete range of injectors, ejectors, water lifters, steam sanders, carriage-heating apparatus, and all details for the vacuum brake.

Tyer and Co., Ltd., Dalston, London, signalling engineers show one-wire and three-wire position instruments, permissive block instruments, absolute and permissive tablet instruments and other electrical apparatus with which their name is associated. All these appliances are so well known to railway engineers that there is no necessity for us to describe them. The remark may, however, be made that all reveal that thoroughness of workmanship which is so essential in block instruments and single line token machines.

A less-known method of controlling single lines is the key token—Fig. 426—which acts on the same principle as Tyer's tablet instruments. No token can be withdrawn without the permission of the signalman at the other end of the section, which permission cannot be given if a key has already been withdrawn from either of the two instruments applicable to that section. A withdrawn key can be restored, if required, to the instrument whence it came, without being taken through the section. The instrument has only one moving part, and that is an electrically controlled rotary commutator, which, during the process of rotation, forms, with the key, a single mechanism. It rotates in an anti-clockwise direction as a key is withdrawn, but cannot rotate in that direction without current flowing from the companion instrument at the other end of the section. When a key is inserted the commutator is turned in a clock-wise direction. The withdrawal of a key puts the companion instruments out of phase and, consequently, another key cannot be withdrawn from either end of the section; the insertion of a key causes the instruments to synchronise and either may then again be used. There are four slots to act as receptacles for the keys, and a key may be deposited in or withdrawn from any one of them. Whilst the instrument is very simple, it is fool-proof, and cannot be tampered with. It can be worked by current from batteries or by magneto-generated power, and may be used for absolute or permissive working and as a siding lock.

The control of the starting signal for entering a section by the tablet for that section is also shown. This, it will be remembered, was a feature that arose out of the Abermule disaster of January, 1921. That accident evidently also led to the substitution of aluminium for leather in the pouches in which the tablet is placed before being handed to the enginemen. The cover of the leather pouch rather hid the lettering on the tablet, but the aluminium pouches need no cover and the tablet is fully exposed.

A special feature in mechanical signalling is the anti-friction bearing shown in the accompanying illustration—Fig. 427. The roller bearing is, it will be noticed, enclosed in the cage on the right, and it will be observed that the rollers cannot bunch together nor tilt. The bottom brass washer shown on the left, is fitted to prevent wet or dirt working in between the lower face of the boss of the crank and the stud plate. Within the rollers is a grease cup. When the crank has to be removed for any purpose or whilst it is being fixed, if new, the fitter or smith carries the cage in his pocket, and when the work is finished it is inserted and protected by the cover seen in the centre, which protects the grease cup and makes the bearing thoroughly proof against wet and dirt. The same idea is applied to locking bar clips, and its application is possible to every form of crank, rod compensator, wheel, &c. Cranks so fitted have been in use for some months on sections of two of the railway groups, and they are found to be much easier

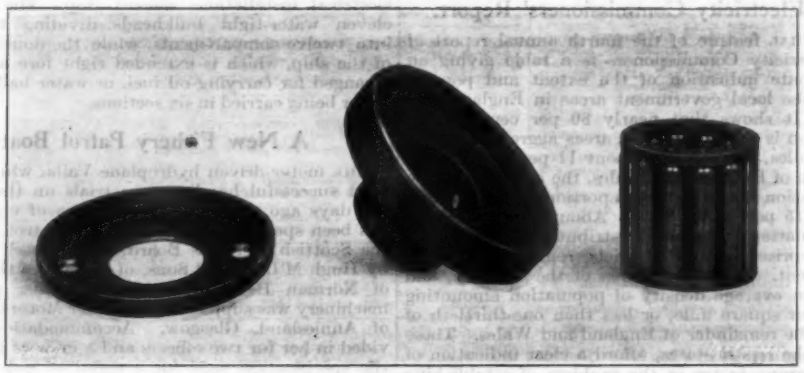


FIG. 427—ROLLER BEARING FOR RAILWAY SIGNALS—TYER

* No. XXI. appeared September 12th, 1924.

to work, allow for greater operating distance from the box, and, it is obvious, reduce lubrication and maintenance.

ELECTRICAL ENGINEERING EXHIBITS.

A. REYROLLE AND CO., LIMITED.

A metal-clad super power station switch panel, similar to those which have been supplied to the Carville, Dalmarnock, Nechells, and Barking stations, is one of the principal exhibits of A. Reyrolle and Co., Limited, of Hebburn-on-Tyne. The panel at Wembley represents the construction of three distinct sizes, for one phase is constructed for 3000 ampères at 12,000 volts, another phase for 1500 ampères at 22,000 volts, whilst the third phase is designed for 800 ampères at 22,000 volts. An end view of the switch is shown in Fig. 430, whilst Fig. 431 shows the contacts. In order to economise space, switch panels of this type are generally arranged in pairs back to back, for when the switches are erected in this way the distance between the centres of one pair to that of the other pair is only 11ft., whilst the width is only 21ft., and the maximum overall height 10ft. 6in., as shown in the plan and cross section in Fig. 432.

The normal breaking capacity of the circuit breakers belonging to these panels is 1,500,000 kilovolt-ampères, based on a short circuit on a generating plant of 150,000 kilowatts with a 10 per cent. reactance. Panels already in commission are said to have proved to be quite capable of breaking this very large amount of power. The makers of this gear call particular attention to the fact that it calls for a very small amount of space as compared with that needed by the cubicle type of switchgear, and that in these days, when the cost of buildings is high, this is a matter of very great importance. To meet an emergency during the war the first six panels of this type were installed on the loading bay of the Carville "B" power station for the control of the power from plant having a capacity of 40,000 kilowatts. The switches were dispatched from the maker's works completely assembled and were lifted from the crocodile truck on which they were carried, set down on the loading bay within the engine-room and connected up and put into commission one by one within a few days of leaving the factory.

The drawing, Fig. 432, gives a cross section of one of these panels as shown at Wembley. The standard equipment comprises duplicate bus-bars, bus-bar selectors, the main oil circuit breaker, feeder isolators, current and potential transformers for protective and metering purposes, and cable trifurcating boxes. The letters on the drawing indicate the following parts:—A, duplicate bus-bars; B, oil-immersed bus-bar selectors; C, oil circuit breaker main contacts; D, oil circuit breaker horizontal break auxiliary contacts; E, oil-immersed cable isolator; F, protective current transformers; G, potential transformers; H, operating solenoid; J, operating link unit; K, gland for outgoing cable; L, interlocking shafts; M, gas vents; N, main circuit breaker tank; and O, the complete withdrawable unit. Each bus-bar or each separate phase is separately surrounded by a metal sheath and is run in solid with compound. The trunk connection from the bus-bars to the selector switches and from thence to the main circuit breaker and on the cable isolators are also separately enclosed and surrounded with compound. Very careful precautions are taken when filling in the compound to eliminate all air spaces.

The bus-bar selectors and cable isolators consist of separate non-automatic single-phase oil switches operated by rods radiating from a central installation of levers resembling the controls of a marine engine. The levers controlling these isolating devices are interlocked with one another and with the main circuit breakers, so that they cannot be operated in the incorrect sequence. The gear for lowering the oil tanks is also interlocked and the tanks cannot be lowered when the conductors enclosed in the tanks are alive. It is also impossible for any conductor to be made alive until it is completely enclosed in the oil tank. The outgoing feeder or bus-bar connection, as the case may be, has to be earthed by a separate lever-operated contact arm included in the general interlocking scheme before the tanks can be lowered, and the act of lowering the tanks operates another earthing arm which disperses any charge on the contacts leading to the main circuit breaker.

The illustration Fig. 428 shows the draw-out portion raised clear of the tank and the fixed portion, whilst Fig. 429 gives a view of the top of the panel. The bus-bars, selectors, and cable isolators and the interlocking system are supported by twelve stout steel pillars from a common cast iron bed-plate frame around the main circuit

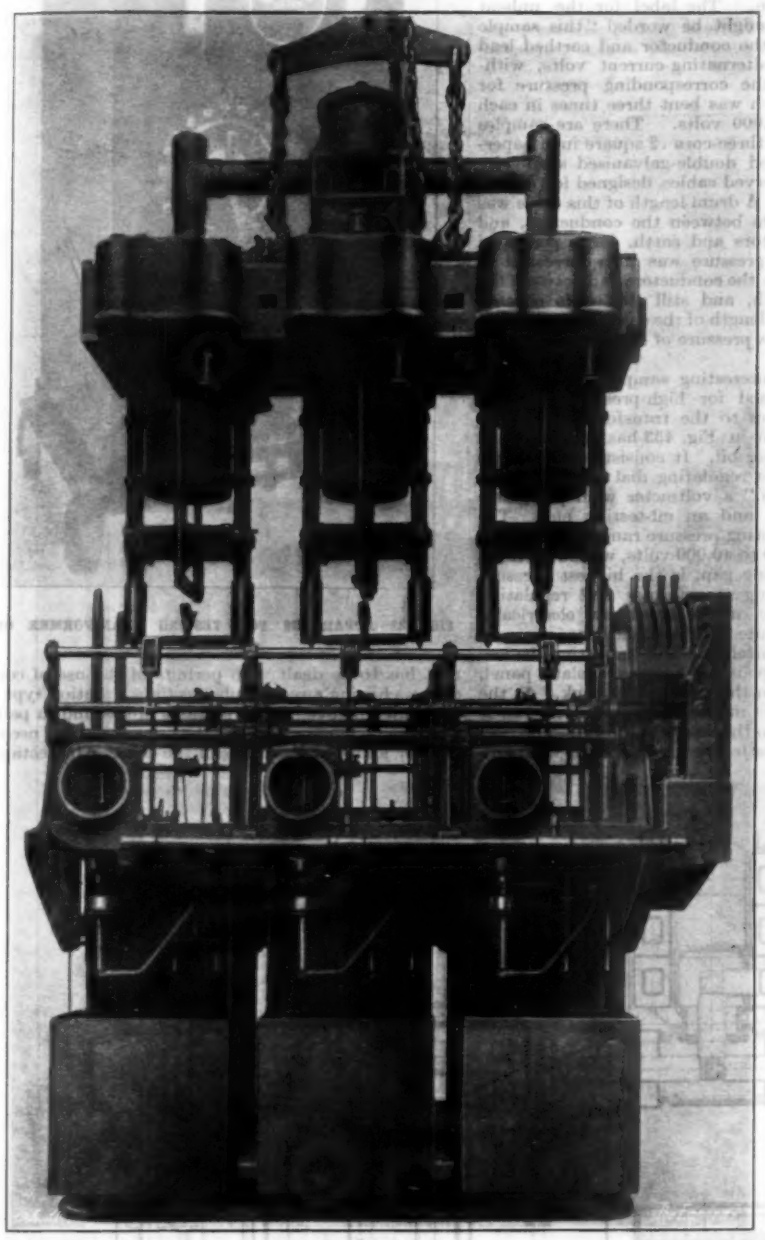


FIG. 428—SWITCH WITH TOP PART RAISED—REYROLLE

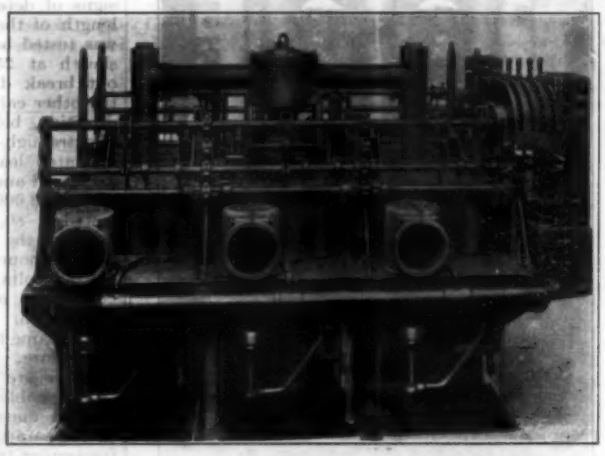


FIG. 429—TOP OF SWITCH—REYROLLE

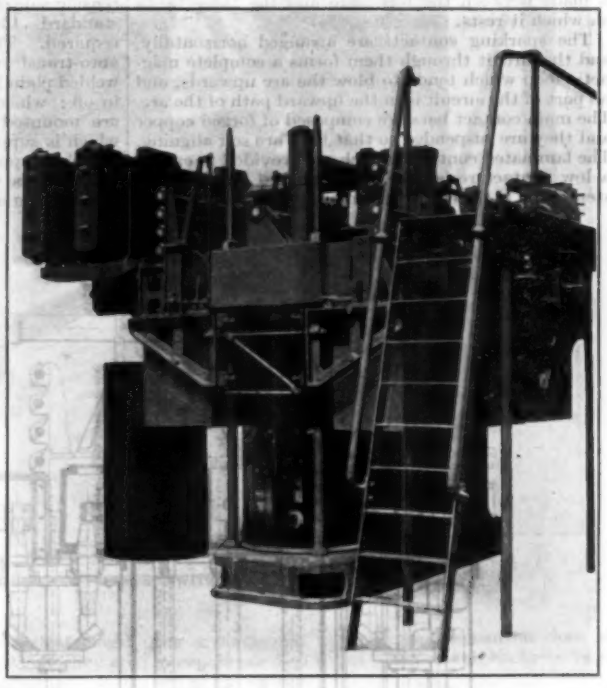


FIG. 430—END VIEW OF SWITCH—REYROLLE

breaker. For all operations, both electrical and mechanical, interlocking is provided. The main circuit breaker consists of three single-phase oil-immersed circuit breakers which are united by a common top plate. The tanks are cylindrical and are constructed of heavy boiler plate, which is electrically welded. They are about 2ft. 9in. in diameter and 5ft. 3in. high and rest on the common bed-plate. The common top plate is composed of cast steel and is heavily ribbed.

On the occasion of a recent short circuit on a large system one of these top plates withstood an impact, as indicated by the deflection of a piece of boiler plate over an orifice, of 5000 lb. per square inch. Below this top plate are the operating portions of the circuit breaker and also the stems and contacts for one leg of the selector switches on one side, and one leg of the cable isolator on the other side, together with the electrical circuit connections, whilst above the plate the closing and tripping solenoids and lever gear are mounted. The complete three-phase unit can be withdrawn vertically from the fixed framework by

means of an overhead crane within the limits fixed by a continuation of four of the main supporting pillars which form vertical guide bars, and its upward movement operates doors or caps which cover the orifices left in the top plates of the selectors and cable isolators. The crane is embodied in the interlocking scheme, for it can only obtain its power for lifting purposes from a trailing cable with a plug which has to be inserted within a socket fixed to the framework of the panel, and the socket is not energised unless the main circuit breaker is open. An oil-tight joint

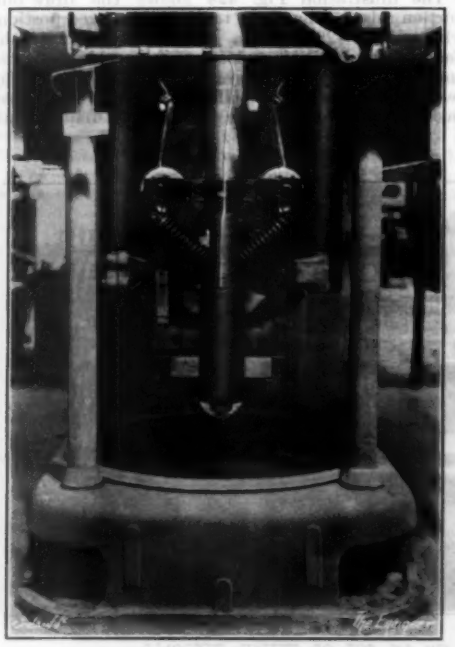


FIG. 431—SWITCH CONTACTS—REYROLLE

is made between the top plate and the three tanks on which it rests.

The sparking contacts are arranged horizontally, and the circuit through them forms a complete magnetic loop which tends to blow the arc upwards, and no part of the circuit is in the upward path of the arc. The main contact bars are composed of forged copper and they are suspended so that they are self-aligning. The laminated contacts, which are provided to ensure a low contact resistance, are mounted on the fixed stems both in the case of the main circuit breaker and the selector and isolating switches. The laminated contacts point inwards, and under heavy current conditions they tend to tighten up. The insulation of the panel has received very careful attention.

All the tubular insulators are composed of Bakelised paper and are constructed on the condenser principle, so as to ensure equal distribution of the electrical stresses. Every insulator is either completely oil immersed or compound filled, and there are no air spaces. All the conductors in the switch top plate and bus-bar are heavily taped with Empire cloth, in addition to being surrounded with compound. The panel is electrically operated from a control board.

JOHNSON AND PHILLIPS.

Among the cable exhibits of Johnson and Phillips, Limited, of Charlton, are two samples of the .25 square inch single-core cable for the electrification of the Brighton section of the Southern Railway. One of these samples has been submitted to an extra high-tension test after bending. The cable is designed for a working single-phase pressure of 32,000 volts, or 55,000 volts for three-phase working. A drum length of this cable was subjected to 80,000 alternating-current volts for 30 minutes, 64,000 volts for 72 hours continuously, and 80,000 volts for 12 hours continuously, and after these tests the cable showed no signs of deterioration. The label for the unbent length of the cable might be worded "this sample was tested between the conductor and earthed lead sheath at 250,000 alternating-current volts, without break down," the corresponding pressure for the other cable, which was bent three times in each direction, being 200,000 volts. There are samples of extra high-tension three-core .2 square inch paper-insulated lead-covered double-galvanised steel wire armoured and jute-served cables, designed for a pressure of 33,000 volts. A drum length of this cable was tested at 80,000 volts between the conductors, and between the conductors and earth, for a period of half an hour. The pressure was then increased to 100,000 volts between the conductors and between the conductors and earth, and still the cable resisted breakdown. A short length of the cable was subjected to the same tests at a pressure of 200,000 volts without failure.

There are other interesting samples of the company's cables designed for high-pressure working, but we must pass on to the transformer exhibits. The apparatus shown in Fig. 433 has been designed for testing transformer oil. It consists of a step-up testing transformer, a regulating dial switch, a two-pole "hold-in switch," a voltmeter with protective fuses, a pilot lamp, and an oil-testing cup. The equipment gives a testing pressure range on the high-tension side of from 0 to 40,000 volts, which, with the standard .15in. testing gap, is the highest pressure required. The testing transformer and regulating auto-transformer are mounted in an electrically welded plain boiler plate tank, and they are immersed in oil; whilst the switchgear and indicating devices are mounted on a polished enamelled slate panel, which is supported on the transformer tank. As the complete apparatus is mounted on swivel wheels, it can easily be placed in the desired position. The low-tension side of the testing transformer and the regulating auto-transformer can be designed so that the set can operate on any available low-tension supply.

Typical transformer coils are on view. A so-called "cross-over" coil is wound with a double-cotton-covered round wire of comparatively small cross section. The coil is wound continuously with several layers, each composed of a number of turns. These coils are employed for small and medium-sized transformers, which do not have to deal with heavy currents, and a number of coils are assembled together to form a complete winding. When the current

FIG. 433—APPARATUS FOR TESTING TRANSFORMER OIL

that has to be dealt with permits of the use of conductors having a rectangular section, "section type" coils are employed. The sections are wound in pairs from single lengths of wire, thus obviating the necessity for joints on the inside of the coils. The sections have one turn per layer, the several turns of each section being wound radially, one over the other. Several pairs of sections are connected in series to form a complete transformer winding.

A "spiral type" coil is also shown. These coils may consist of a single rectangular strip conductor

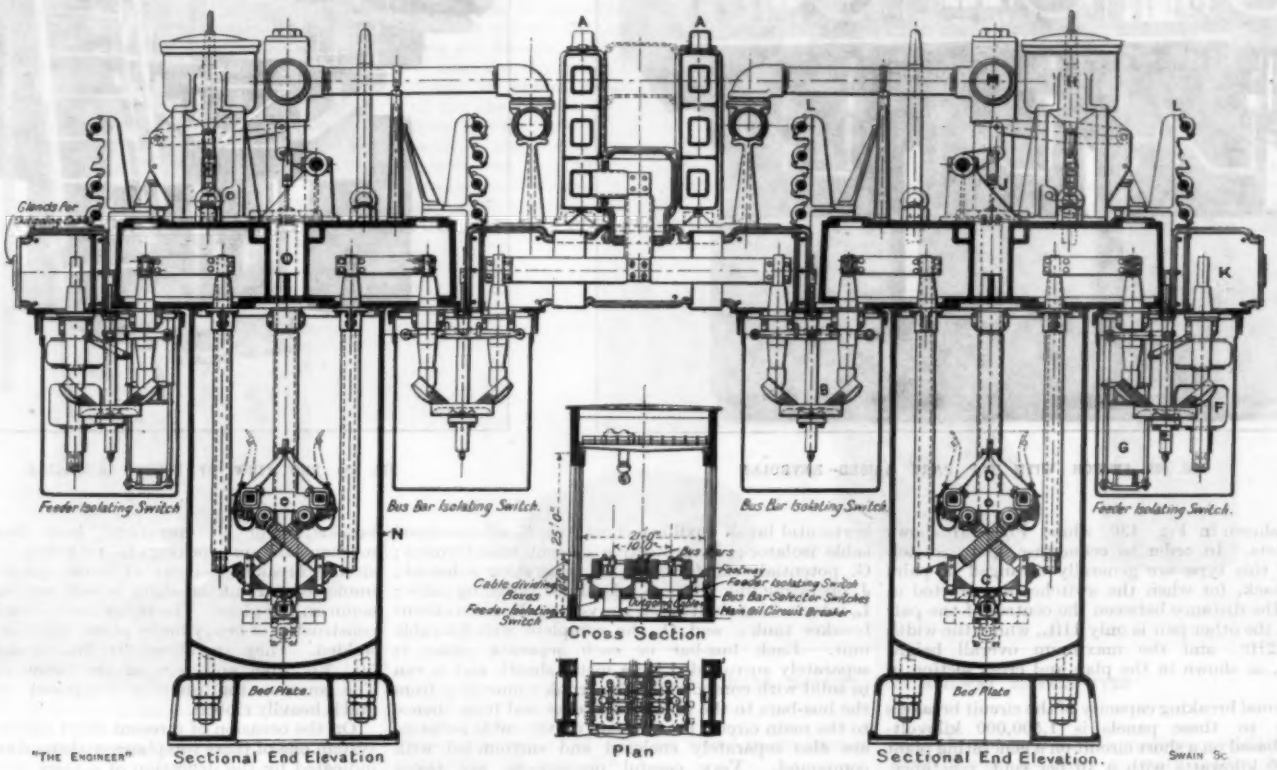


FIG. 432—CROSS SECTION OF SWITCH—REYROLLE

wound on edge or a number of square wires in parallel. In either case the conductor is wound in a single spiral layer directly on to a substantial insulating cylinder. These coils are extremely robust, and they offer the advantage that each individual turn is in direct contact with the cooling oil, and the danger of local heating of the windings is avoided. Moreover, the coils are very compact and solid, and are capable of being treated during manufacture by heat and pressure in a manner which prevents the possibility of shrinkage occurring after prolonged service. A complete winding made up of section-wound coils is shown assembled, as it is in practice, on the limb of a transformer, and the winding is provided with adjustable tappings, which are brought out to the terminals of a tapping switch, which permits the tappings to be changed without removing the cover of the transformer or without changing any of the cable or internal connections. A 500 kilovolt-ampère transformer, with a tapping switch, is shown in Fig. 434, whilst Fig. 436 shows the complete transformer in its case. The design of the tapping switch, we are told, has involved considerable trouble and expense. The switch which has now been produced is strong and simple, and there is no possibility of de-arrangement. The fixed and moving contacts are supported on insulated mild square steel bars, and the insulation is recessed to receive the contact supports, with the result that it is impossible for the contact fingers to be displaced, either radially or transversely in relation to the supporting bars.

A set of distance thermometers manufactured by the Cambridge and Paul Instrument Company is mounted on the stand, and they are connected by capillary tubing to three 500 kilovolt-ampère Johnson and Phillips transformers in the power-house and sub-stations supplying power to the Exhibition. As these thermometers indicate the temperature of the transformers, they give an indication of the amount of load being carried.

A weatherproof transformer is shown mounted in position on the cross arms of a transmission line pole. It is suitable for use where a simple and inexpensive equipment is desired to enable small consumers in outlying districts, such as farms, villages, &c., to be supplied with cheap current for power and lighting purposes. The three 500 kilovolt-ampère transformers installed in the power-house and sub-stations are designed for use on a 3300-volt, three-phase, 50-cycle supply, and they transform the pressure down to 415 and 240 volts for the four-wire three-phase supply. The primary windings are connected in mesh and the secondary windings in star. Tappings are provided on the high-tension windings to compensate for a variation in the supply pressure of 5 per cent. above or below the normal pressure of 3300 volts. The tapping leads are connected to a tapping switch of the type described so that the tappings can be changed without removing the transformer cover or changing any internal or external connections. The tapping switch is provided with an indicating device for showing the position of the switch and is so arranged that it may be locked in any position.

During the various stages of manufacture the windings of these transformers were subjected to special treatment by heat and pressure to ensure the finished windings being thoroughly solid and compact and therefore free from appreciable shrinkage after lengthy service. Notwithstanding this special treatment, adjustable axial coil supports are fitted which permit any slight shrinkage of the windings which may occur to be taken up, thus ensuring that the coils are rigidly braced at all times. These supports consist of heavy steel clamping rings mounted on the top of the windings upon which they are compressed, by a number of long vertical adjusting screws. The adjusting screws pass through bosses welded to the core clamping structure, and are of sufficient length to reach nearly to the top of the tank, where they are further supported by an angle iron structure. It is thus possible to tighten the supports to take up any coil shrinkage without removing the transformer from its tank or without withdrawing any of the oil. A special hand wheel box spanner is supplied with each transformer to fit the adjusting screws. In addition to the distance reading thermometers, which are connected to these transformers to indicate their temperature on the stand, each transformer is provided with a dial type indicating thermometer mounted on the cover. Each transformer has a compound filled cable dividing box to accommodate 0.075 square inch three-core paper insulated lead-covered cable. The general appearance of these transformers can be gathered from Figs. 434 and 436.

A Johnson and Phillips rotary converter transformer and a static balancer are shown connected to a rotary converter and direct-current generator respectively on Crompton and Co.'s stand. A 25 kilovolt-ampère transformer made by this firm is used for lighting the model coal mine, and a 10 kilovolt-ampère transformer for lighting the museum.

Among the switchgear exhibits is a "P" type oil switch as shown in Fig. 435. Switches of this type are built for capacities ranging from 200 ampères at 33,000 volts to 1000 ampères at 11,000 volts. The switch illustrated consists of three single-pole units which, when necessary, are coupled together to form a three-phase switch. Pending actual tests at the National Proving Station the switch shown has been conservatively rated at 250,000 to 300,000 kilovolt-ampères. It can be arranged for mechanical or electrical operation, and it is fitted with a power reduction mechanism so that the power required for tripping is very small. The tripping mechanism is arranged so that the switch can be tripped in any position of the closing stroke when the circuit has been made. This obviates the possibility of the switch holding in as the result of minute blobs of metal which sometimes occur on the contacts when a switch is closed on a heavy fault and when the switch contacts have to be pushed right home before the tripping mechanism comes into operation.

The switch can be fitted with transformer-operated or direct-operated overload trip coils. When a time lag is required with the direct-connected trip coils air vane time lag devices are fitted. No operating mechanism is exposed on the top of the oil switch frame. It is situated underneath this frame and is therefore free from dirt, but the main advantage of the arrangement is that the mechanism does not interpose earthed metal between the contacts on the top of the switch.

The tanks are made up of boiler plate $^{3}/_{16}$in. thick at the sides and $\frac{1}{4}$in. thick at the bottom with reinforcing bands. They are held to the switch frame casting by very stout bolts. Each tank is fitted with a plywood lining arranged so that there is a layer of oil between the wood frame and the side of the tank capable of standing the full voltage of the system. The top of the tanks are fitted with a gasket to prevent oil leakage. All bearings for the operating shaft which project through the oil switch frame casting are an engine fit and prevent any oil splashing at the joints. Large baffled vent pipes are provided. All the current carrying parts are made of hard-drawn copper. The moving contacts are wedge shaped with self-aligning finger type fixed contacts so arranged that on the occurrence of a heavy short circuit they tend to make more perfect contact and not be blown out. The insulation throughout is composed of "Bakelite," and the bushing type insulators are fitted with a strong porcelain shield at the base so as to protect the "Bakelite" from being damaged by arcing within the oil switch tanks. The switch has a long break, for there are two breaks in series per pole. It also has a large head of oil and a quick speed of arc rupture. When these switches are required to

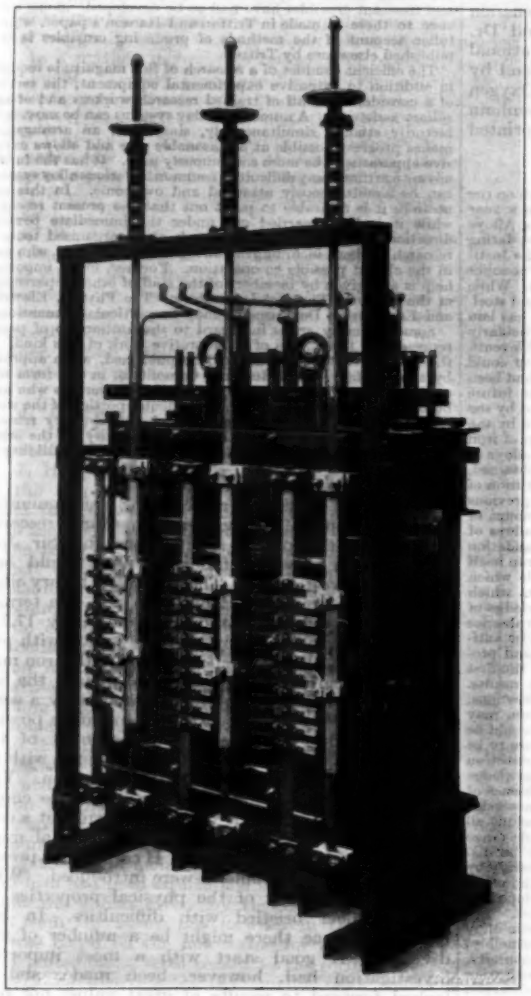


FIG. 434—TRANSFORMER WITH TAPPING SWITCH

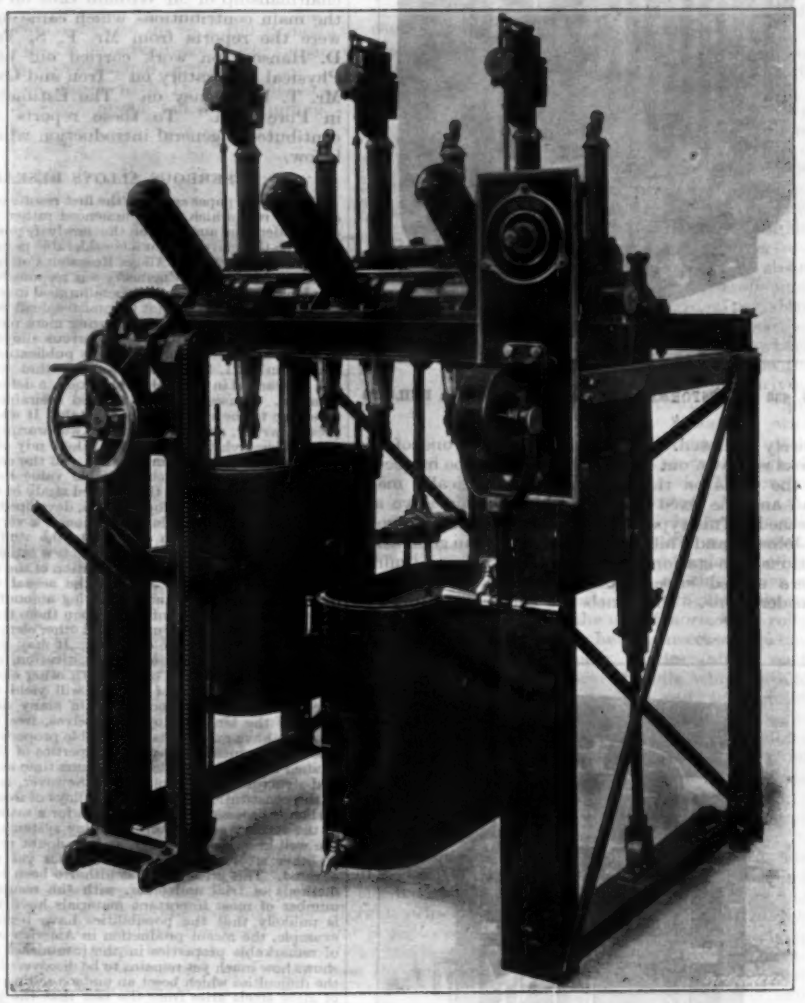


FIG. 435—"P" TYPE SWITCH—JOHNSON AND PHILLIPS

deal with very large powers an auxiliary spring contact is fitted to give a specially high rate of arc rupture. A well-designed oil dashpot is provided.

The truck type switch shown in Fig. 437 is another of this firm's exhibits. A number of these switches can, of course, be arranged to form a truck type switchboard. The switches and other apparatus are mounted on a movable truck, and when the trucks are in the working position all the "live" metal is

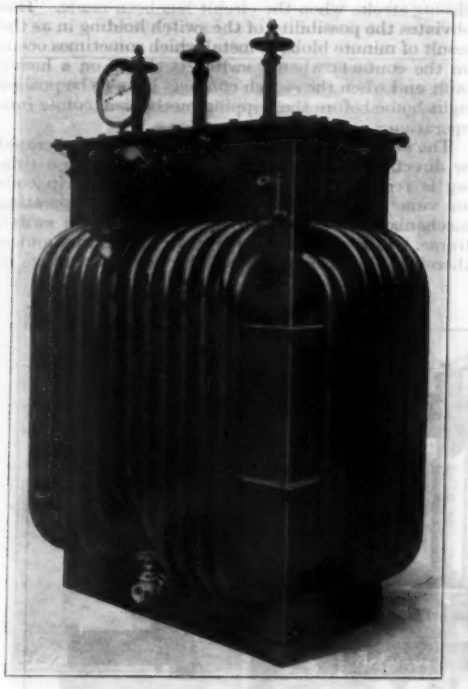


FIG. 436—TRANSFORMER IN CASE—JOHNSON & PHILLIPS

entirely enclosed. When, however, any one of the trucks is drawn out to enable the gear to be inspected all the parts on the truck are automatically made dead and the fixed contacts which remain alive are screened. This type of switchgear has been designed by Johnson and Phillips, Limited, for use in generating stations, sub-stations and for use in works and mines where skilled supervision is limited by economic considerations. The panels are constructed in three

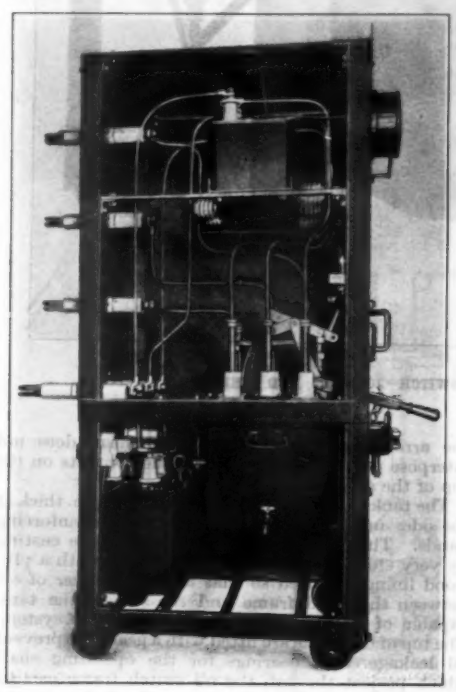


FIG. 437—TRUCK TYPE SWITCH—JOHNSON & PHILLIPS

standard sizes to suit the different currents and voltages and different short-circuit conditions. The ratings of the three standard types B1, B2, and B3 are given in the following table :—

	Amperes.	Volts.
B1	300	650
	300–500	650
B2	300	3,300
	300	3,300
	300–500	6,600
B3	500	6,600
	300	11,000

These switches, which are designed for use on three-phase circuits, meet most requirements, but larger sizes for currents up to 2500 ampères at 650 volts and 1000 ampères at 3300 volts can be supplied in conjunction with the maker's self-aligning contacts. Each cubicle is made in two parts : (*a*) the stationary portion bolted to the floor, containing the bus-bars, fixed contacts, cable box, or cable sealing end ; and (*b*) the truck or movable portion, containing the oil switch, current and potential transformers, and the instruments which are mounted on the front plate. The general design of the cubicle interior ensures ample electrical clearances between "live" parts and between these parts and the earthed metal. Except in the case of the B1 type of truck switch, insulating partitions of fireproof material are fitted between phases on the bus-bars, enclosing for all practical purposes each bus-bar in a separate compartment.

Iron and Steel Institute.

No. II.*

WHEN the Conference was resumed under the chairmanship of Sir William Ellis on September 5th, the main contributions which came under discussion were the reports from Mr. F. S. Tritton and Dr. D. Hanson, on work carried out at the National Physical Laboratory on "Iron and Oxygen," and by Mr. T. E. Rooney on "The Estimation of Oxygen in Pure Iron." To these reports Dr. Rosenhain contibuted a general introduction which is reprinted below.

FERROUS ALLOYS RESEARCH.

The present paper contains the first results of a research on the alloys of iron which was commenced rather more than a year ago, under the auspices of the newly formed Ferrous Alloys Research Committee. For a considerable period of years, dating from 1890 to 1921, the Alloys Research Committee of the Institution of Mechanical Engineers was responsible for the conduct of a long series of important metallurgical investigations. While some of the reports to that Committee dealt with iron and steel, the tendency of its activities during more recent years has lain strongly in the direction of non-ferrous alloys, and particularly of alloys of aluminium. With the publication of the Eleventh Report in 1921, however, it was felt that while finality could not be reached in research of this kind, a definite stage had been attained. Consequently, it seemed desirable to devote future attention to the study of other metals. It was suggested by the present writer, and the suggestion was warmly approved by the Alloys Research Committee, that the study of the alloys of iron was now of particular importance. In the case of the alloys of aluminium, results of considerable value had been obtained, principally by means of the detailed study of the constitution of a number of complex alloy systems, developed from the previous study of the simpler alloys. Although a very large amount of research work has been devoted to the study of the alloys of iron in the form of steel, it seems that a satisfactory foundation for a full knowledge of the constitution of the alloys of iron itself is still lacking, mainly because the actual alloy steels which have been studied contain a varying amount of carbon, which exerts so profound an influence upon them that a knowledge of the simple binary alloys of iron and other elements in the absence of carbon has still to be obtained. It may confidently be anticipated that the study of the constitution, structure and properties of binary alloys of iron with other elements, in the first place in the absence of carbon, will yield important results. Such results may be looked for in many different directions. Some of the binary alloys themselves, free from carbon, may prove to have exceptionally valuable properties which would be discovered, since the physical properties of the alloys are to be studied as far as possible at the same time as their constitution and structure. The central fact, however, is that a knowledge of the constitution of the binary alloys of iron in the absence of carbon is necessary as a foundation for a satisfactory knowledge of the ternary and quaternary alloy systems, which include all the well-known alloy steels, and no doubt cover a whole range of other steel alloys whose properties yet remain to be discovered. This great field has hitherto been explored mainly by methods of trial and error, with the result that although a number of most important materials have been developed, it is unlikely that the possibilities have been exhausted. For example, the recent production in America of a magnetic alloy of remarkable properties in the iron-nickel series (Permalloy) shows how much yet remains to be discovered. Fundamentally, the difficulties which beset an understanding of the constitution of alloy steels arise from the fact that the presence of carbon complicates their behaviour to such an extent that a complete study of the ternary equilibria is necessary. As a basis for this study the thorough exploration of the binary alloys of iron with the more important elements, such as nickel, chromium, manganese, &c., and also with oxygen, is essential.

A programme of investigation of the kind indicated is obviously very wide and abounds with experimental difficulties, which arise from the high temperatures involved in the production of iron alloys and from the ease with which the alloys are contaminated either by oxygen or carbon or both. The production of pure iron alloys in the laboratory, in quantities sufficiently large to allow of the study of physical properties as well as constitution, implies the initiation of a research on a scale at least as large as that on which the investigations of aluminium alloys have in recent years been carried out at the National Physical Laboratory.

In order to make it possible to carry out a programme of this kind, involving a large annual expenditure continued over a considerable number of years, Sir John Dewrance, K.B.E., then acting as chairman of the Alloys Research Committee, brought about the formation of a new Committee, called the Ferrous Alloys Research Committee, which, unlike the old Committee, is not connected with any one society or institution, but is composed of representatives of a number of the leading scientific and technical societies and institutions, including the Royal Society, the Institution of Civil Engineers, the Institution of Mechanical Engineers, the Institution of Naval Architects, the Institution of Electrical Engineers, the Iron and Steel Institute, and the Institution of Mining and Metallurgy. Under the auspices of this Committee, and with the concurrence of the Advisory Council of the Department of Scientific and Industrial Research, a beginning has been made upon the programme of ferrous alloys research, but not as yet on the full scale that is desirable. Thus, the physical tests on iron and iron-oxygen alloys which are described in the paper by Tritton and Hanson have, of necessity, been carried out on unduly small samples, owing to the great cost in time and money which would have been involved in the production of these materials in larger quantities.

It is, perhaps, desirable to indicate the nature of the work involved in a research of this kind, in order to explain the requirements in experimental equipment and trained workers essential for its satisfactory progress. A preliminary step in the study of these alloys is the provision of materials of the highest purity. Iron itself must be obtained free from all measureable admixtures, and the same applies to the alloying elements, such as chromium, manganese, &c. It has proved impossible to obtain them commercially, and their preparation in the Laboratory has had to be undertaken. As considerable quantities are required, this has already occupied much time and equipment ; in some cases, the methods of producing the pure metal have themselves involved a lengthy and difficult research, for which special apparatus has had to be developed and constructed.

The melting of such pure metals and their alloys, so as to avoid contamination by traces of carbon, has also proved a matter requiring prolonged experimental work. During the earlier stages of the investigation, the best furnaces available were the "graphite-ring" type of electric resistance furnace, which has been developed at the National Physical Laboratory, and in these it was essential to evolve a type of refractory muffle which would protect the molten metals from carbon at temperatures near 1600 deg. Cent. The use of these furnaces and of such methods of protection is still essential for obtaining high-temperature thermal curves of the alloys. More recently, the work has been much facilitated by the use of the Ajax-Northrup high-frequency induction furnace. Even with this apparatus, which is a costly item of laboratory equipment, considerable difficulties have had to be overcome, while the quantity of iron alloy which can be melted, in the total absence of carbon, in the 25 kilovolt-ampère size of furnace is much too small to allow of satisfactory physical testing.

A further series of fundamental difficulties arises from the high temperatures used and the great chemical activity of the molten metals and their vapours. Special methods of protecting thermo-couples and of preparing highly refractory and resistant crucibles have had to be developed. Some reference to these is made in Tritton and Hanson's paper, while a fuller account of the methods of producing crucibles is to be published elsewhere by Tritton.

The efficient conduct of a research of this magnitude requires, in addition to extensive experimental equipment, the services of a considerable staff of trained research workers and of subsidiary assistants. A number of alloy systems can be most satisfactorily studied simultaneously, since such an arrangement makes progress possible at a reasonable rate and allows expensive apparatus to be more continuously used. It has the further advantage that many difficulties common to various alloy systems can be simultaneously attacked and overcome. In this connection, it is desirable to point out that the present research, while it is being carried out under the immediate personal direction of the writer, is the work of an organised team of research workers, including metallurgists and chemists, who work in the closest possible co-operation. Further, much important help is also given by members of the staff of other departments of the National Physical Laboratory. The Physics, Electrical and Engineering Departments may be particularly mentioned.

Some difficulty arises in regard to the authorship of papers representing the results of collaborative work of this kind. In the present case the results will be published, when approved by the Ferrous Alloys Research Committee, in the form of a series of papers in the names of the research workers who have been mainly concerned with that particular portion of the work. A general heading and, when required, introductory remarks will, however, serve to preserve the continuity of the whole series of researches and to indicate the writer's responsibility for the research as a whole.

Sir Robert Hadfield, representing the committee which is superintending this important research, referred to the public spirit shown by Sir John Dewrance in providing funds for what would be a prolonged investigation. The number of binary alloys of the group could be as many as 230, the ternary alloys numbered 2530, and the quaternary 17,710. It was decided very wisely to make a start with pure iron. He himself was much interested in the iron manganese non-carbon group, and just before the war had had carried out in his works laboratory a series of experiments. He hoped that it might be possible to present the Institute with an account of this work, so that the results might be compared with the results given in the paper under discussion. Very little attention had been paid in the past to copper in this connection, but it was now shown that a comparatively small percentage of that material might have a considerable influence. If carbon was present as well then other problems were introduced. When it came to a study of the physical properties the whole subject bristled with difficulties. In heat treatment alone there might be a number of subdivisions. A good start with a most important investigation had, however, been made, and he looked forward to results of great value, not only from the scientific side but in the practical application of this scientific knowledge.

Professor C. H. Desch also referred to the difficulties of the research which had been undertaken, and which had proved so formidable in some branches of the subject to American workers that it had been abandoned. The equilibrium diagram produced by the authors could be accepted as representing the conditions which existed when iron and oxygen only were present. By adopting the Ajax furnace for their work and testing that appliance, useful service had been given, and the metallurgical department of Sheffield University now possessed an improved type of furnace in the design of which advantage had been taken of the experience with the older type at Teddington. The furnace installed at Sheffield had been built in England. Turning to the results of the research at the National Physical Laboratory, the effect disclosed as to the influence of oxygen in solid solution was somewhat surprising. In ordinary practice it was not the effect of oxygen on iron which was in question, but the effect of oxygen on one of the dissolved metals. Manganese had been mentioned in that connection. The small change in the magnetic properties of the material arising from the presence of oxygen in solid solution was another unexpected result. Mr. Rooney's paper would be very useful, but the difficulty of dealing with metals would be slag inclusions.

Dr. W. H. Hatfield said the investigation was a most fitting field for the activities of institutions like the National Physical Laboratory and University

* No. I. appeared September 12th, 1924.

Laboratories. It was work of a fundamental character which could not be undertaken in works laboratories. At the same time he could not emphasise too strongly his opinion that the paper dealt with one of the most important problems with which steel makers were confronted, i.e., the relationship of oxygen to iron. There were still many points to be determined in that connection; it was not definitely known, for example, to what extent oxygen was in solid solution in iron. As far as the quantitative results given in the paper were concerned, the figures for the amount of oxygen which might be associated with iron in the solid states as distinct from solid solution were, he believed, correct. More information on various aspects of the question were required by steel makers—working open-hearth furnaces, and the work done by the authors was leading up to that information being available. Steel makers would be, he was certain, pleased to send to those working at this subject samples of various products for the determination of the oxygen which was admittedly a difficult task.

Dr. H. C. H. Carpenter regarded the work described as among the best of the kind that had yet been done. With the temperatures employed the authors had been able to deal with an entirely new range of the equilibrium problem. At least it could be said that something was known as to the equilibrium of iron and oxygen. There was one point which illustrated, to a marked degree, the influence of oxygen on the metal. Twenty years ago he had been able to give a figure for the freezing point of iron, which was 1519 on the optical scale, and the difference between that value and the figure of 1535 given in the paper was very small, so that as far as the freezing point was concerned the influence of oxygen was very slight. He accepted the diagram given in the paper.

Mr. F. W. Harbord asked whether the melting of iron and oxide together would have the same physical effects as if the oxides were generated in the mass as in the Bessemer converter. Under steel works conditions it might perhaps be possible to get a greater degree of solubility of one element in the other. That point might be determined by the examination of samples of metal from the converter.

Mr. J. E. Fletcher expressed, on behalf of the industry, the debt of gratitude due to those who had carried out this work.

Mr. J. H. Whiteley said steel makers wanted to know the amount of free oxygen present in the slag and the ferric oxide content. The presence of oxide in the metal had many effects.

In the reply to the discussion, Dr. Hanson, who promised to deal fully with the discussion by correspondence, said the authors recognised the shortcomings of the diagram, but he thought it could be claimed that the results, as far as they went, tended to show that oxygen had no deleterious effect on iron. The metal was sound and ductile and particularly free from brittleness under tensile and rolling tests, although showing some brittleness under impact. With regard to the extension of the work to the open-hearth furnace, that ought to be done, but up to the present time they had not been able to attack that part of the task, as it meant an extension of the work on the binary system and many examinations of the ternary system, and would be a more difficult investigation. It was true, as Dr. Carpenter had pointed out, that the melting point of iron had been ascertained by earlier workers, and that the values given by them did not differ greatly from the figure put forward in the paper, which was based on the new value for the melting point of palladium. With regard to the form of the oxide and its distribution, that might have some effect, but it had been noted that in the low oxide melts, although a number of rounded particles were detected, they had very little influence on ductility, on tensile strength, or on the cold-rolling properties of the material. If those particles existed as iron sulphide, however, a different result might be expected. Mr. Harbord had raised the question of oxide generated in the metal, and if that would increase the amount of oxide present. That might be the case.

Dr. Rosenhain said those engaged in this difficult work needed help and encouragement, and what had been said during the course of the discussion would be much appreciated. At the best the present group of investigators could not hope to see the task through to the end, but they were part of an organisation which would outlive them, and that organisation would one day see the work completed.

Sir William Ellis, in concluding the discussion, referred to the great interest of the Institute in this research, and the very valuable work which was being accomplished.

Dr. Rosenhain then presented a contribution on "The Hardening of Steel," and it was decided that this paper should be discussed by correspondence.

A paper by Mr. A. Hultgren on "Improvements in the Brinell Test on Hardened Steel Balls, Including a New Method of Producing Hard Steel Balls," was read in abstract by the author, who had come from Gothenburg to be present at the Conference. In this paper the author describes a method of producing steel balls considerably harder than those heretofore available, and therefore especially suitable for Brinell tests on hardened steel. The method consists in cold working ordinary hardened polished steel balls. The surface portion is thus hardened to a sufficient depth to enable the ball to withstand considerably greater pressures than ordinary hardened steel balls do, without appreciable permanent deformation. By suitable etching, the depth to which the cold working effect may be made to penetrate has been determined to be about 0.75 millimetre for a 10-millimetre ball, and 0.4 millimetre for a 5-millimetre ball. The use of etched Brinell balls is suggested as a means of increasing the accuracy of measuring the Brinell impression on hardened steel. In this connection it is recommended that the sensitivity of measurement of the Brinell microscope should be increased.

Sir Robert Hadfield referred to the interest which the paper had evoked, and raised a question in connection with the statement of the author that, whereas when ordinary balls were tempered at 150 deg. Cent. the effect was to increase the hardness figure obtained, tempering at 225 deg. Cent. lowered the rebound hardness. More information on that point was required, and it would be of interest if the author could give some information as to the effect on the toughness of the material by different temperatures of tempering. He noted that the author had got hardness figures up to a 700 Brinell number, but it would be an advantage if the range could be extended up to 800 Brinell hardness.

Dr. W. Rosenhain dealt with the possible inaccuracies in result which might follow the dulling of the ball by etching to which reference was made in the paper. The roughing of the surface gave increased friction and diminished the depth of the depression, but it was doubtful whether that effect was large enough to be measurable.

Mr. Hultgren, in a short reply, said he had not carried out any shock tests, and could not give the information asked for by Sir Robert Hadfield. The balls tempered at 225 deg. Cent. certainly gave the lowest rebound value. On the subject of Brinell figures of 800 he had no information, and had not in his own work obtained any values of that order. He did not think the point raised by Dr. Rosenhain as to the possible effect of dulling the ball was of any importance as regarded the results obtained.

Other papers included in the agenda were taken as read. They included the following contributions:—"The Nature of High-speed Steel," by Messrs. Marcus A. Grossman and Edgar C. Bain; "Examination of Iron from Konarak," by Dr. J. Newton Friend and Mr. W. E. Thorneycroft; "The Effect of Changes in Total Carbon and in the Condition of Carbides on the Specific Resistance and on Some Magnetic Properties of Steel," by Messrs. E. D. Campbell and G. W. Whitney; "Investigations on the Herbert Pendulum Hardness Tester," by Dr. Carl Benedicks and Mr. Vilhelm Christiansen; and "The Changes of Volumes of Steels During Heat Treatment," by Dr. Leslie Aitchison and Mr. G. R. Woodvine.

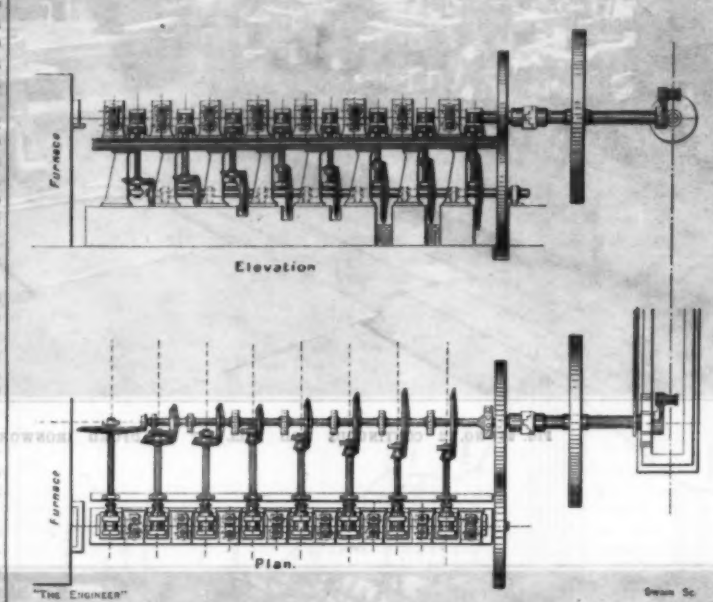


FIG. 65—THE FIRST CONTINUOUS WIRE ROD MILL

British Wire-drawing and Wire-working Machinery.

No. IX.—WIRE FACTORIES.*

A VERY prominent place in the production of wire of all sorts is taken by the works of Richard Johnson and Nephew, Limited, at Bradford Ironworks, on the outskirts of Manchester, and some account of the establishment might have been included earlier in this series of articles, as it could be made to embrace practically the whole art of wire making.

At these works steel, bronze, and copper are converted from the rough billet or ingot into wire and more elaborate products, so that the whole of the many processes can be followed out; but, in order to reduce the length of this article as much as possible, it has been deliberately left until some of the phases of wire-drawing had been dealt with, so that processes which are more or less common practice might be passed over lightly. There are, however, several peculiarities about the plant and processes of the Bradford works, and it consequently seems better to group them into one article, rather than tack them on to sections dealing with individual subjects.

The works are also noteworthy through being the birthplace of the continuous system of wire rod rolling, as it was there that Mr. Bedson's first continuous mill was erected, after a preliminary trial, run in private, in 1862. This mill, of which a drawing is given in Fig. 65, remained in continuous operation until 1884, and comprised a series of sixteen pairs of rolls, arranged alternately vertically and horizontally. This alternate arrangement was adopted so that the rod, after having been deformed in one plane was offered up to the next pair of rolls in the best position for further rolling. The mill was capable of rolling down billets 18ft. long and 1¼in. square, weighing 75 lb. each, into No. 5 wire rods. The output was about 20 tons in a turn of 10 hours.

In 1866 a second continuous mill was put down, and still remains in commission. This mill, part of which is shown in Fig. 66, also comprises alternate pairs of vertical and horizontal rolls all driven by spur and bevel gearing from a remarkable old steam engine. The mill rolls some 30 tons of rods per shift, but, like its predecessor, suffers from the drawback that mill scale falls down on to the gearing for driving the vertical rolls, and naturally interferes with their running. It was, in fact, this trouble which led Mr. Charles H. Morgan, of Worcester, Mass., to adopt all horizontal rolls in his mill, an example of which was described in the first of this series of articles. Incidentally to the use of horizontal rolls, it became necessary to employ guides after each set of rolls which would turn the rod through 90 deg., and it is the maintenance of these guides which is one of the chief cares of the engineer in charge of a modern continuous wire rod mill.

Subsequent to 1866, several other mills were put down at the Bradford Iron Works, and finally, in 1916, the mill illustrated by the plan view—Fig. 68—and the engraving—Fig. 67—was constructed to the designs of Mr. J. P. Bedson. It follows the Morgan principle in having all the rolls horizontal, but is distinct in having all of them positively driven by toothed gearing. The mill has now been in operation for some time, but it is doubtful if it has ever had an opportunity for showing what it really can do, although it has produced as much as 1250 tons of rods a week. The daily capacity is some 120 tons per 7½ hours shift.

The scheme of the mill can best be followed with the aid of Fig. 68. The billets, which are 2in. square by 28ft. long, and weigh 364 lb. each, are heated in a furnace fired with producer gas. They are fed down the sloping bed of the furnace, as they are heated, by hydraulic rams, and are pushed out at the lower end by a bar driven forward by a pair of rolls. The heated billets go, two at a time, into the roughing mill, which has eleven pairs of horizontal rolls. On emerging from the last pair of roughing rolls the rods are guided into two pipes which run between the two sets of finishing rolls. These pipes are very plainly shown in Fig. 67.

A man stationed at the outlet end of each pipe seizes the end of the rod as soon as it emerges, and, turning round, snips off the ragged end in a pair of constantly running shears. He then enters the rod into the first of the finishing train of seven pairs of rolls. The rod is thus turned back on itself and is delivered towards the furnace again, with the result that a loop is formed as shown in Fig. 69. The loop extends down a slope, as in the case of a Belgian mill, and is tended by a lad to insure that it does not get entangled. "Turtlebacks," or fairleads, are fixed on the floor at intervals to insure that the back end of the rod is pulled clear of the last pair of rolls, and does not get chilled by the cooling water, which is constantly pouring all over the rolls. The finished rod is led to one or the other of a set of coilers, and when it has been coiled is tipped off, by hydraulic

* No. VIII. appeared September 5th, 1924.

OLD AND NEW CONTINUOUS WIRE ROD MILLS

RICHARD JOHNSON AND NEPHEW, LIMITED, MANCHESTER, ENGINEERS

FIG. 66—NO. 2 CONTINUOUS ROD MILL AT BRADFORD IRONWORKS

FIG. 67—GENERAL VIEW OF NO. 5 MILL AT BRADFORD IRONWORKS

power, on to a conveyor, where it gradually cools down on its way to the dispatching yard.

The rolls in this mill are all 12in. in diameter, and the finishing set runs at 900 revolutions per minute, so that the rod is delivered at a speed of about 32 miles per hour. With a red hot rod travelling at this speed there is obviously great danger to the men if it should get out of control, and it is for this reason that the finishing trains of rolls are covered in by the wire grids shown in Fig. 67. The chief contingency that has to be guarded against is the "breaking out" of the rod, which may be caused by a ragged ended rod sticking in the guides between the rolls. The concentration of energy involved in the high-speed rolling of wire rods may be gauged by the result of a break-out, as, if the rod then meets a rigid obstruction, it is piled up into a solid mass so thoroughly welded together that if the mass is sawn through no joints can be detected.

The drive for this mill is unique in so far as it is transmitted entirely through toothed gearing. The wheels have double-helical teeth, all machine cut, and are totally enclosed—see Fig. 67—so that they may be provided with a forced system of lubrication. The gears, naturally, are so proportioned that the rolls run at a speed increasing appropriately as the section of the rod is reduced. It has, by the way, been the custom of the American Morgan Company to advocate the use of a belt drive on account of its supposed greater smoothness, but Mr. Bedson says that he has experienced no troubles through the positiveness of the toothed gear drive. There are flexible couplings between the gear shafts and the rolls themselves.

The driving power for the mill is supplied entirely by electric motors, by the English Electric Company. The roughing mill is worked by a 2750 horse-power motor, of which we give an illustration in Fig. 70.

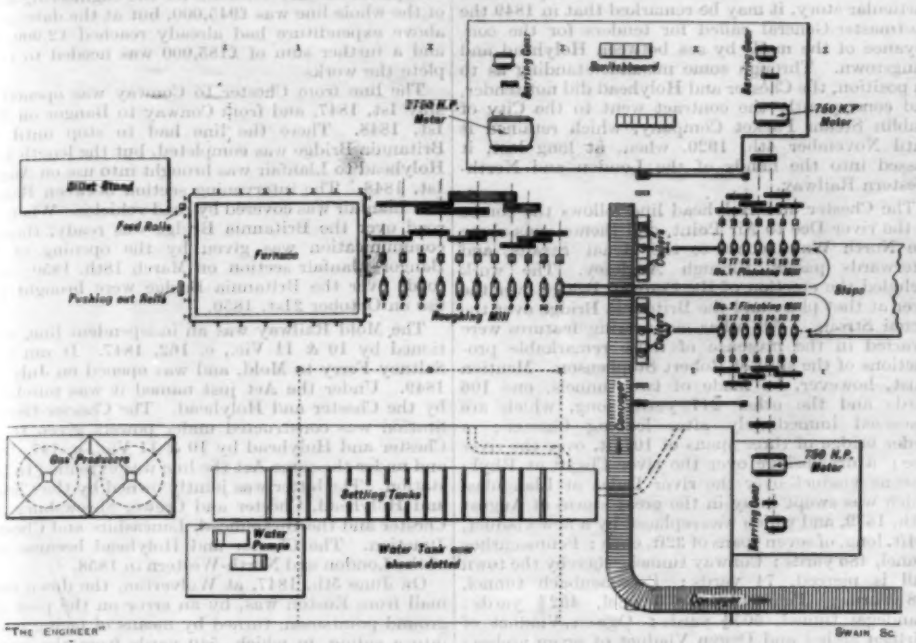
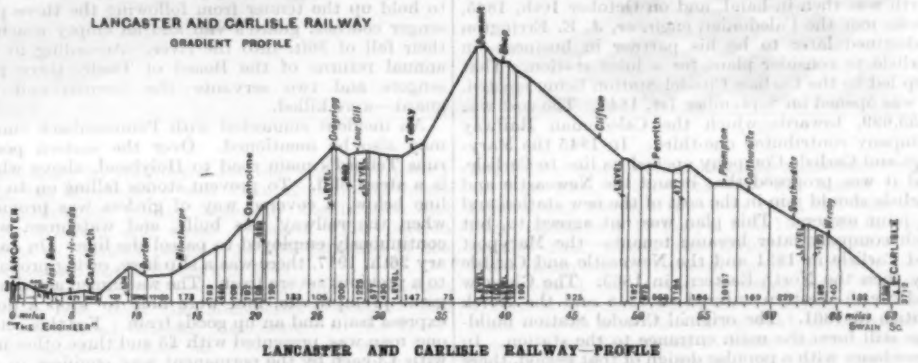


FIG. 68—GENERAL ARRANGEMENT OF NO. 5 ROD MILL

A noteworthy feature about the electrical equipment of this mill is the elaborate system of underground passages, which not only provide accommodation for the cable connections to all the various motors, but are also used for supplying fresh, clean air directly underneath each unit.

The operation of the mill is carried out from a control platform in the motor house, which commands a view of the whole plant. On this platform there are push buttons for starting and stopping all the motors, together with indicating lamps and ammeters. The whole scheme has, in fact, been so developed as to centralise the control as far as possible, and to minimise laborious or dangerous work about the mill.

(*To be continued.*)



LANCASTER AND CARLISLE RAILWAY—PROFILE

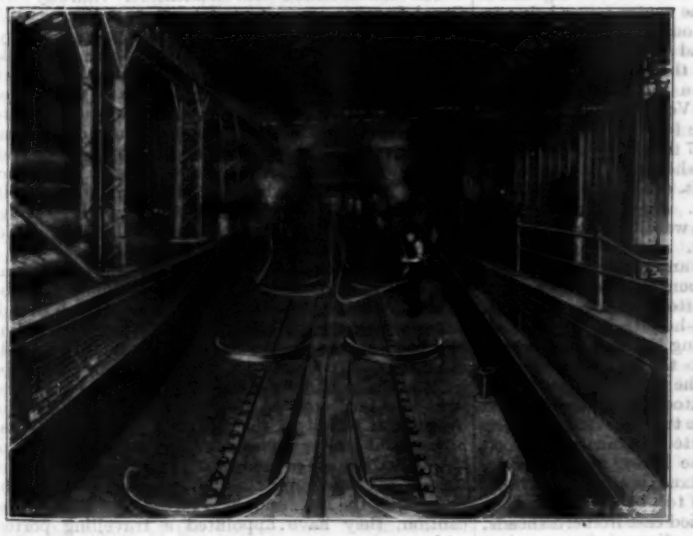


FIG. 69—LOOPING SLOPE OF NO. 5 ROD MILL

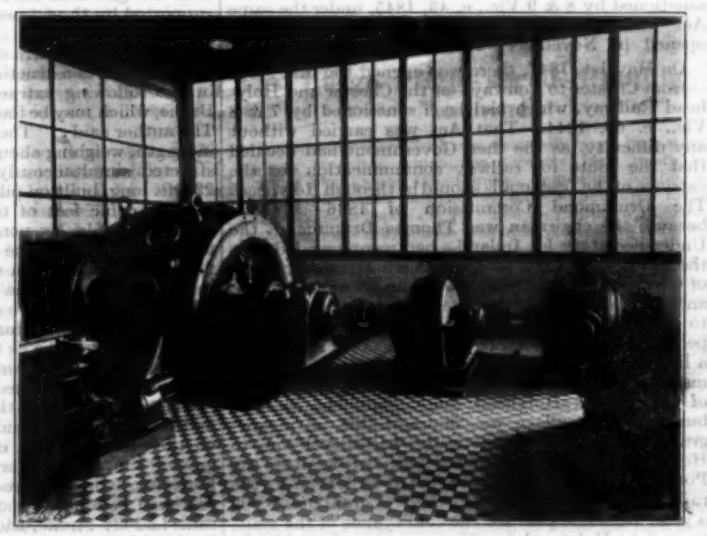


FIG. 70—2750 HORSE-POWER ROUGHING MILL MOTOR

The smaller motor, on the right, and the reduction gearing, are for barring round the mill when getting ready for work. The main motor runs at 500 revolutions per minute and takes three-phase current from the Corporation mains, at 6600 volts and 50 cycles. The finishing trains of rolls are also driven by 6600-volt motors, of 750 horse-power each, which run at 750 revolutions per minute.

One Hundred Years of British Railways.

No. XII.*

PART II.—THE FIRST HALF-CENTURY.

THE LONDON AND NORTH-WESTERN RAILWAY.

In our last issue we traced the history of the various companies which, on July 16th, 1846, became the London and North-Western Railway. A less but very important event of the same year was the opening of the Lancaster and Carlisle Railway. There were two schemes for reaching the Scottish border from Lancaster. One was to cross Shap Fell at 600ft. above sea level and reach Carlisle by Penrith, whilst the other was to cross Morecambe Bay, bridge the Duddon Estuary, and go by the West Cumberland coast. The latter would have a maximum rise of only 90ft., but it would have necessitated heavy reclamation work, and would have had a total length of 90 miles instead of 60 miles *vid* Penrith. Locke recommended the former route, and it was sanctioned by 7 & 8 Vic., c. 37, 1844.

The gradient profile is shown in the accompanying illustration, which explains itself. The line does not start at the Lancaster and Preston Station in Lancaster, but by a junction with that line slightly to the south of that company's station, which it leaves on the east and proceeds due north to a station near the Castle, the Lancaster and Preston terminus being a goods station. Immediately after leaving Lancaster, the railway crossed the river Lune and the Morecambe main road. Here there was a bridge of three laminated timber arches, of 120ft. span each, which were followed by seven brick arches, each of 53ft. span. Dr. W. B. Worthington, in his presidential address of November 1st, 1921, at the Institution of Civil Engineers, made the following interesting reference to this bridge:—"Subsequently, in 1845, as resident engineer under Locke, my father (S. B. Worthington, northern divisional engineer, London and North-Western Railway, 1859–1886) constructed one of these (laminated timber-arch) viaducts over the river Lune at Lancaster. This viaduct carried the main line traffic of the London and North-Western Railway to Scotland. When that company acquired the Lancaster and Carlisle, it was decided that the timber arches should be replaced by an iron structure. The viaduct would have continued to carry the traffic safely for some years longer in spite of the increased weight of locomotives since its construction, but a large oil works had been established in its immediate vicinity, and the increased risk of the destruction of the bridge

* No. XI. appeared September 12th, 1924.

by fire, which would have severed the connection of the London and North-Western with Scotland, was the determining factor. So in 1865–6 my father replaced the timber arches after a life, somewhat prematurely terminated, of twenty-one years by a less inflammable structure consisting of continuous wrought iron box girders carried by the original stone piers, with cross girders and a timber floor. By the courtesy of Mr. Trench, chief engineer of the London and North-Western Railway, I am able to complete the history of the bridge to the present time. The old box girders and cross girders still continue in use, but the timber floor was replaced in 1894 by steel beams carrying longitudinal chair timbers and floor plates. This history speaks well for the careful maintenance of the old wrought iron structure which has been in use for fifty-five years."

The next work of note, always excepting the heavy gradient, is a viaduct on the main line, and one on the Ingleton branch, at Low Gill. The line then passes through a narrow valley, wherein runs the river Lune. Here is the Dillicar cutting, whence nearly 70,000 cubic yards of solid blue rock were removed, and beyond it the Borrow Viaduct, 68ft. above water level, consisting of three arches, each of 45ft. span. Near this place the Lune had to be diverted, and an embankment for the railway built on its former site. At the summit at Shap, which is 916ft. above Ordnance Datum, there is a cutting 60ft. deep. Here are the celebrated Shap Granite Works. Approaching Penrith is the Lowther Viaduct, 500ft. in length, consisting of six arches, each of 60ft. span, followed, before Penrith is reached, by a viaduct, 300ft. long, with five arches of 50ft. span each over the river Eamont.

The line was opened from Lancaster to Oxenholme on September 22nd, 1846, and thence to Carlisle on December 17th, 1846. The Kendal and Windermere's branch from Oxenholme was opened to Kendal on the former date and to Windermere on April 21st, 1847. This branch was sanctioned by 8 & 9 Vic., c. 32, 1845, and was leased to the Lancaster and Carlisle Company in 1859.

The city of Carlisle had enjoyed railway communication since 1836, in which year the Newcastle and Carlisle Railway was opened That company's station was in London-road, and the Lancaster and Carlisle made use of it when the railway from the south was opened on December 17th, 1846. The Caledonian line from Carlisle to Edinburgh and the north was then in hand, and on October 10th, 1845, Locke met the Caledonian engineer, J. E. Errington —destined later to be his partner in business—in Carlisle to consider plans for a joint station. That step led to the Carlisle Citadel Station being erected. It was opened on September 1st, 1847. The cost was £155,689, towards which the Caledonian Railway Company contributed one-third. In 1845 the Maryport and Carlisle Company opened its line to Carlisle, and it was proposed that it and the Newcastle and Carlisle should join in the cost of the new station and be joint owners. This plan was not agreed to, but each company later became tenants—the Maryport and Carlisle in 1851 and the Newcastle and Carlisle (by then the North-Eastern) in 1863. The Glasgow and South-Western entered in 1848 and the North British in 1861. The original Citadel Station buildings still form the main entrance to the station. In accordance with a popular design of that period, there was only one platform, which was on what would be the up side of the line. There was one running road and a loop by its side, with two goods lines beyond. Two crossovers were provided between the main and loop, and, in addition, there was a bay road at each end of the station.

The Bedford Railway was a line from Bletchley on the London and Birmingham to Bedford. It was sanctioned by 8 & 9 Vic., c. 43, 1845, under the same Act was leased to the latter company, and was opened in November, 1846.

On May 1st, 1847, there was opened the first stage —from Chester to Conway—of the Chester and Holyhead Railway, which had been sanctioned by 7 & 8 Vic., c. 65, 1844. That Act was carried without any difficulty, as the then Government had decided that the route for railway communication for the carriage of the Irish mails should be through Holyhead. The Drummond Commission of 1836—so-called because the chairman was Thomas Drummond, the Under-Secretary for Ireland—had recommended that the sea route should be from Porth Dynllaen, north of Cardigan Bay, to Wicklow, a distance of 60 miles, and that a railway should be built from Shrewsbury to Porth Dynllaen. In 1838 the Chester and Crewe people got George Stephenson to make a survey for a line from Chester to Holyhead, with a view to the mails going by that route. His report was in favour of the Chester–Holyhead route, since the Shrewsbury–Porth Dynllaen was impracticable, as regards gradients, against a practically water-level line to Holyhead. The Government decided against the Porth Dynllaen route and accepted Holyhead as the railway terminus. It went further. A grant of £30,000 a year was to be paid for the conveyance of the mails by rail to Holyhead for five years certain, with the option of renewal for a further five years, and Holyhead Harbour was to be improved. On April 3rd, 1846, the Chester and Holyhead Railway Company agreed with the Government to contribute one-quarter of the cost of the construction of a harbour of refuge and a steam packet pier. Such payment by the company, however, was not to exceed £200,000. The extension to Admiralty Pier was sanctioned by 10 & 11 Vic., c. 238, 1847, and by 11 & 12 Vic., c. 60, 1848, the railway company was authorised to purchase, hire and use steamboats. To complete this particular story, it may be remarked that in 1849 the Postmaster-General called for tenders for the conveyance of the mails by sea between Holyhead and Kingstown. Through some misunderstanding as to its position, the Chester and Holyhead did not tender, and consequently the contract went to the City of Dublin Steam Packet Company, which retained it until November 4th, 1920, when, at long last, it passed into the hands of the London and North-Western Railway.

The Chester and Holyhead line follows the course of the river Dee to Air Point, and thence runs along the North Wales coast to the Menai Straits, and afterwards passes through Anglesey. The work included the erection of the Conway Bridge over the river at that place and the Britannia Bridge over the Menai Straits. All other engineering features were dwarfed in the presence of these remarkable productions of the skill of Robert Stephenson. Mention must, however, be made of two tunnels, one 106 yards and the other 217 yards long, which are traversed immediately after leaving Chester; a girder bridge of three spans of 107½ft. over the river Dee; a drawbridge over the river Clwyd at Rhyl; a stone viaduct over the river Dulas at Llandulas, which was swept away in the great storm of August 17th, 1879, and which was replaced by a new viaduct, 224ft. long, of seven spans of 32ft. each; Penmaenrhos tunnel, 486 yards; Conway tunnel, whereby the town wall is pierced, 74 yards; Penmaenbach tunnel, 718 yards; Penmaenmawr tunnel, 452¾ yards; Llandegai tunnel, 505½ yards; Ogwen Viaduct of thirteen arches and Degyn Viaduct of seven arches; Bangor tunnel, 912½ yards; Belmont tunnel, 613¾ yards; Bodorgan, 413¾ and 115 yards; and the Bodorgan Viaduct of nineteen arches.

Before leaving the above works and dealing with the two principal bridges, it may be remarked that one of the cast iron girders of the Dee Viaduct failed on May 24th, 1847—only a few months after the railway was opened. A passenger train belonging to the Shrewsbury and Chester—afterwards the Great Western—was passing at the time, and only the engine managed safely to reach the other side and to hold up the tender from following the three passenger coaches, guard's van and an empty coach in their fall of 36ft. into the river. According to the annual returns of the Board of Trade, three passengers and two servants—the fireman and the guard—were killed.

An incident connected with Penmaenbach tunnel may also be mentioned. Over the eastern portal runs Telford's main road to Holyhead, above which is a steep cliff. To prevent stones falling on to the line below, a covered way of girders was provided when the railway was built, and watchmen were continuously employed to patrol the line. On January 26th, 1917, there was a slip here, owing probably to a previous severe frost. The watchmen acted with great promptitude, and were able to stop a down express train and an up goods train. For this action one man was presented with £5 and three other men with £3 each by the permanent way engineer in the presence of their fellow-workmen. There used to be a similar covered way at the western end, but both have now been replaced by masonry arches.

The Conway Tubular Bridge consists of two wrought iron tubes, each 412ft. long—one tube for each line—without any central support. It cost £150,000. The Britannia Tubular Bridge also has two wrought iron tubes, but is 1511ft. long and is supported by three towers, the centre tower being on the Britannia Rock. The outer towers are each 460ft. from the centre one and 230ft. from the abutments. The construction of the bridge is best told in the following extract from the paper by Alfred Bache, which may be found in Vol. 63, Proc., Inst. C.E. The author said: "There are four tubes, each 470ft. in length, weighing about 1587 tons. These were constructed simultaneously on shore upon a platform 2200ft. long, built on piles 27ft. apart, and containing 110,100 cubic feet of timber. As soon as the first tube was ready, six pontoons were brought in underneath it between the piles. Each pontoon was 98ft. in length, 25ft. in width and 8ft. in depth. The rising tide brought the pontoons to bear up against the bottom of the tube and lifted it off the platform, and by means of capstans on shore the whole floating mass was warped so as to bring the tube to the base of the bridge piers, and into the vertical plane, in which it was to be fixed at the height of 100ft. By then letting water into the pontoons they were lowered and withdrawn from under the tube, leaving it resting on the masonry, each end fitted within the vertical groove left in the pier. The lifting was done by powerful hydraulic presses fixed upright on strong cast iron bed-plates upon the top of the piers. The rams had 6ft stroke, and carried cast iron-crossheads, from which descended suspending chairs attached to the tube below. About a month was taken to lift each tube to its final position. The cost was:—Pontoons, ropes, capstans and lifting gear, £37,880; staging and cost of labour for erection, riveting and rising, £25,500; total, £63,380." It may be added that the total cost of the bridge was expected by the directors at the half-yearly meeting on March 11th, 1849, to be £600,000, as against an estimate of £350,000. Conway Bridge, as already related, cost £150,000, instead of the estimate of £50,000. The parliamentary estimate for the engineering work of the whole line was £945,000, but at the date given above expenditure had already reached £2,900,000, and a further sum of £185,000 was needed to complete the works

The line from Chester to Conway was opened on May 1st, 1847, and from Conway to Bangor on May 1st, 1848. There the line had to stop until the Britannia Bridge was completed, but the length from Holyhead to Llanfair was brought into use on August 1st, 1848. The intervening section between Bangor and Llanfair was covered by road vehicles. When one road over the Britannia Bridge was ready, through communication was given by the opening of the Bangor–Llanfair section on March 18th, 1850; both roads over the Britannia Bridge were brought into use on October 21st, 1850.

The Mold Railway was an independent line, sanctioned by 10 & 11 Vic., c. 162, 1847. It ran from Saltney Ferry to Mold, and was opened on July 1st, 1849. Under the Act just named it was purchased by the Chester and Holyhead. The Chester General Station was constructed under powers given to the Chester and Holyhead by 10 & 11 Vic., c. 147, 1847, and under the same Act the line was extended to that station. The latter was jointly owned by the Chester and Holyhead, Chester and Crewe, Shrewsbury and Chester and the Birkenhead, Lancashire and Cheshire Junction. The Chester and Holyhead became part of the London and North-Western in 1858.

On June 5th, 1847, at Wolverton, the down night mail from Euston was, by an error on the part of a ground pointsman, turned by means of facing points into a siding, in which, 540 yards from the points, some coal wagons were standing. The consequence of the collision was that seven passengers were killed. The mail consisted of nineteen vehicles, of which two were provided with hand brakes applicable to four wheels. There were brakes on six wheels of the tender, but they, and the reversal of the engine, were insufficient to stop the train, which was running at 25 miles per hour. The casualities all occurred in a carriage that had been telescoped, and Captain Simmons, the inspecting officer, recommended a standard height for the buffers, in view of the network of railways extending so rapidly. The officer condemned the entrance to the siding being by means of facing points, and the annual report of the Railway Commissioners considered the brake power insufficient. It was recommended that there should be a brake for every fourth carriage. That "would, no doubt, cause a considerable increase in the working charges of railways, but the question is too important to be abandoned on such grounds, and requires the serious consideration of every company."

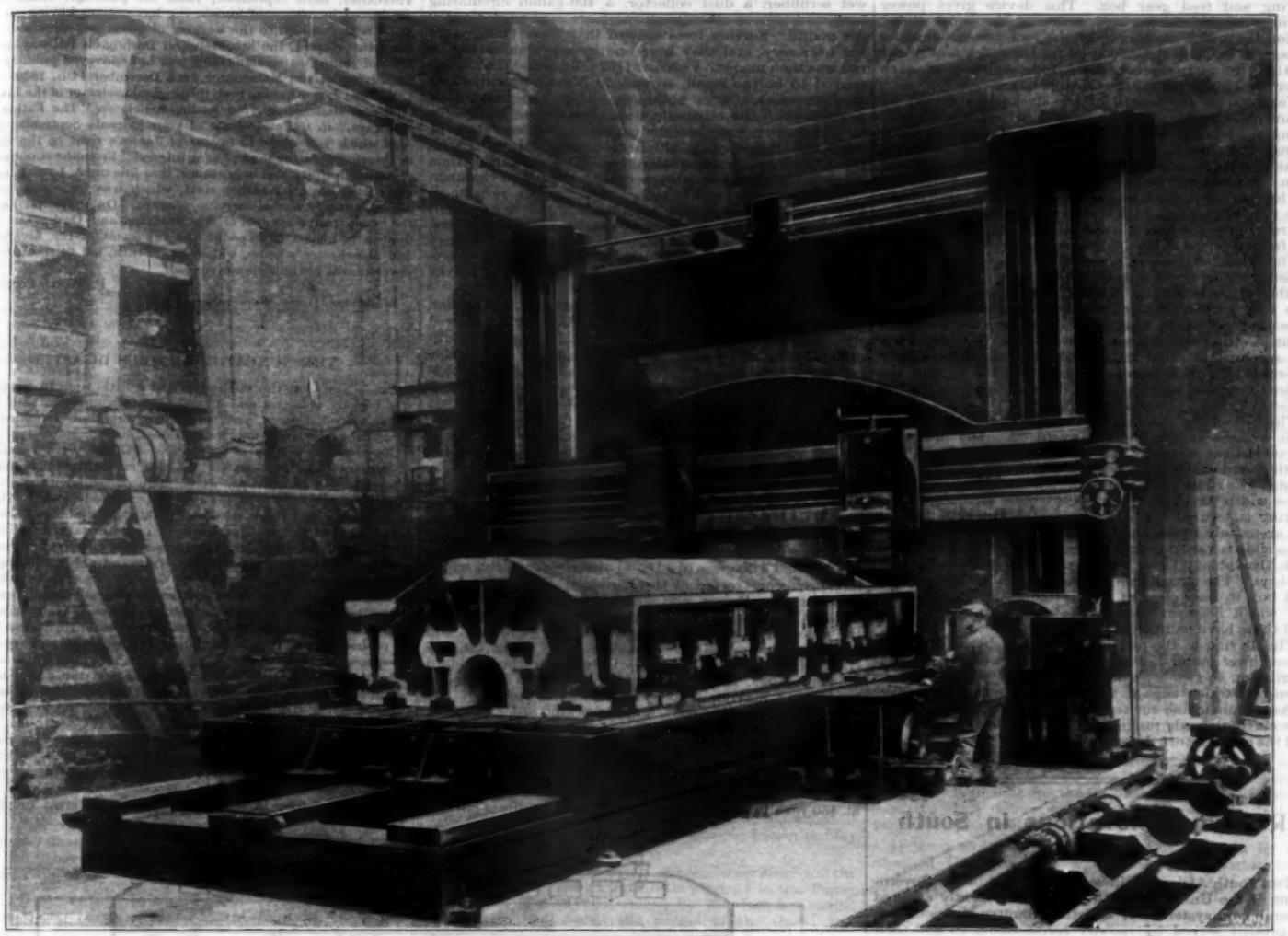
The route between London and the North at that time was through Birmingham. Both the London and Birmingham and the Grand Junction recognised that a line from Rugby, through Nuneaton and Lichfield, would save many miles, and by 8 and 9 Vic., c. 112, 1845, the Trent Valley line was sanctioned. The following year it was purchased by the London and Birmingham, which that year became part of the London and North-Western. There were four bridges over waterways, but none calling for special mention. The Birmingham and Derby section of the Midland passes over the line at Tamworth. Between Colwich and Milford is Shugborough Tunnel, 776 yards long. The line was formally opened on June 26th, 1847.

The Huddersfield and Manchester Railway and Canal Company, sanctioned by 8 & 9 Vic., c. 105, 1845, was formed to construct a railway from Staleybridge to Heaton Lodge on the Lancashire and Yorkshire, together with a branch to Oldham. The Huddersfield and Manchester Canal was to be transferred to it, and a canal owned by Sir John Ramsden was to be purchased. The outstanding feature of the line was the piercing of the Pennine Range by the Standedge tunnel, 3 miles 62 yards long. The other tunnels are:—Staleybridge, 649 yards; Gledholt, 243 yards; Huddersfield, 695 yards. The average gradient from Staleybridge to Standedge is 1 in 125, and from Huddersfield 1 in 105.

It is interesting to relate that the Act sanctioning this railway provided that whilst the line was to be double throughout, it might be single through Standedge tunnel, on the condition that if, after the line had been opened twelve months, the Board of Trade considered it necessary a second tunnel was to be built. The work between Staleybridge and Huddersfield was inspected on July 2nd, 1849, by Captain Wynne on behalf of the Board of Trade, and that officer said in his report: "The company have of their own accord carried into effect the provision of the electric telegraph through Standedge before the opening of the line, and, as a further measure of precaution, they have appointed a travelling porter, without whom no engine is to pass through the tunnel either way." Captain Wynne made a further inspection in May, 1850, and, reporting on the 31st idem, said: "All passenger trains are required to stop at Saddleworth and Marsden stations, and a telegraphic communication takes place between those stations to ascertain that all is right before a

LARGE HIGH-SPEED PLANING MACHINE

THOMAS SHANKS AND CO., LIMITED, JOHNSTONE, ENGINEERS



train is allowed to proceed." The travelling porter referred to in Captain Wynne's first report carried a staff lettered "Standedge Tunnel." It was probably the first train staff ever used. The line from Heaton Lodge to Huddersfield was soon ready, and was opened in July, 1847. The longer portion, *i.e.*, from Staleybridge to Huddersfield, was brought into use on August 1st, 1849. The Oldham branch was opened on July 5th, 1856. In 1847 the Huddersfield and Manchester Railway was acquired by the London and North-Western Company.

The Dunstable Railway was incorporated by 8 & 9 Vic., c. 37, 1845, and the same Act sanctioned its sale to the London and Birmingham. It ran from Leighton Buzzard to Dunstable, and was opened on May 29th, 1848. On August 1st of the same year there was opened the first section of the line that was to take the London and North-Western from Huddersfield on to Leeds. The Huddersfield and Manchester Railway terminated at Heaton Lodge, on the west side of the Lancashire and Yorkshire station at Mirfield. On the east side of Mirfield, near Thornhill, began the Leeds, Dewsbury and Manchester Railway, which was sanctioned by 8 & 9 Vic., c. 36, 1845. That Act authorised a line from Leeds to Huddersfield, but provided that if the Huddersfield and Manchester built its railway, the line from Leeds was to terminate at Mirfield. On this section is Morley tunnel, 1 mile 1609 yards long. The line between Mirfield and Dewsbury was opened in August, 1848, and was worked by the Lancashire and Yorkshire until the line was completed to Leeds on August 1st, 1849. On the latter date trains ran through between Manchester and Leeds. The Midland station at Leeds was used until April, 1869, when the joint North-Eastern and London and North-Western station was opened. The Midland metals between Wellington and Canal Junctions were still used. The London and North-Western Company acquired the Leeds, Dewsbury and Manchester in 1847 by the same Act which transferred the Manchester and Huddersfield to it.

In 1849 four lines not already mentioned were opened. The South Staffordshire was incorporated by 9 & 10 Vic., cc. 300 and 316, 1846, and passed into the hands of the London and North-Western in 1861.

Under 9 & 10 Vic., cc. 322, 323 and 324, 1846, the Shropshire Union Railways and Canal Company was authorised. Whilst certain canal developments resulted, the only railway built was between Shrewsbury and Stafford—opened June 1st, 1849. From Shrewsbury to Wellington the line was made jointly with the Shrewsbury and Birmingham, and hence was ultimately jointly owned by the London and North-Western and Great Western. The portion thence to Stafford became the sole property of the London and North-Western in 1847.

The Manchester South Junction and Altrincham Railway ran from the Manchester–Stockport line at London-road Station, Manchester, to the Liverpool–Manchester line at Ordsall-lane and from Knott Mill to Altrincham, and was built jointly by the London and North-Western and Manchester, Sheffield and Lincolnshire companies. It was sanctioned by 8 & 9 Vic., c. 111, 1845, was opened on July 21st, 1849, and remains jointly owned as above. The line from Edge Hill to Waterloo Goods Station, Liverpool, was opened in August, 1849.

The London and North-Western became one-third owner in the Preston and Wyre Railway in 1849. This line was opened on July 16th, 1840, and it was leased to the Manchester and Leeds—afterwards the Lancashire and Yorkshire—in 1846 under terms which allowed the London and North-Western to join in the lease, but as a junior partner. The Preston and Wyre was the line that gave access to Fleetwood, Blackpool and Lytham.

On February 2nd, 1850, there was opened the Clifton branch which ran from Patricroft on the Liverpool and Manchester to Molyneux Junction on the East Lancashire, a few hundred yards north-east of Clifton Junction on the Manchester–Bolton section of the Lancashire and Yorkshire. This work includes a tunnel 1299 yards long. On May 1st of the same year the first portion of what was called the Rugby and Stamford line was opened. Actually, this line ceased by a junction with the Syston and Peterborough branch of the Midland a tLuffenham. The powers were obtained by the London and Birmingham under 9 & 10 Vic., c. 67, 1846, and the line was opened to Market Harborough on May 1st, 1850; thence to Rockingham on June 1st, 1850, and to Luffenham on May 1st, 1851. Near the end of the line is Morcott tunnel, 458 yards long.

The Buckinghamshire Railway Company was incorporated by 10 & 11 Vic., c. 236, 1847, to absorb the Oxford and Bletchley Junction—9 & 10 Vic., c. 82, 1846—and the Buckingham and Brackley—9 & 10 Vic., c. 233—which ran from Bletchley to Oxford, with a branch from Brackley to Banbury. The line from Bletchley to Banbury was opened on May 1st, 1850; from Clayden Junction, now Verney Junction, to Banbury-road (Islip), Oxford on December 1st, 1850; and the remaining 3¼ miles into Oxford on May 20th, 1851. The line was leased to the London and North-Western in 1851, and that company, under 16 & 17 Vic., c. 205, 1853, put in a connection that joined the Oxford, Worcester and Wolverhampton at Yarnton Junction, which led to a short-lived fast service of trains from Worcester to Euston in competition with the Oxford and Dideot route. By 10 & 11 Vic., c. 114, 1847, an independent company was authorised to make the Coventry and Nuneaton Railway, and under the same Act to dispose of it to the London and North-Western. This line was opened on September 2nd, 1850. The Rugby and Leamington branch, sanctioned by 9 & 10 Vic., c. 368, 1846, was opened in April, 1851. On May 1st, 1851, the Midland trains from the Derby direction ran into the Curzon-street Station of the London and North-Western instead of into the company's own station at Lawley-street.

A Large High-speed Planing Machine.

We illustrate herewith an unusually large high-speed planing machine, which has recently been made by Thomas Shanks and Co., Limited, Johnstone, for one of the largest marine engineering and shipbuilding firms. The machine is especially intended for dealing with heavy Diesel engine work, and an idea of its size will be gathered from the fact that the distance between the uprights is 16ft. 9in., while the height above the table and under the cross slide at its highest is 12ft. 4in., so that all four tool boxes can work simultaneously on a job 16ft. 4in. wide by 12ft. high by 27ft. long.

As will be seen from the engraving, the machine is extremely massive in its construction, the vital parts having received the particular attention of the designer. The cross slide, on which so much depends for accuracy, has exceptional depth and rigidity, and we are informed exhibits no deflection. The table is so deep and so well supported that any risk of distortion either through the weight of the job or the fastening down stresses is completely eliminated. The bed is very wide, and the three broad bearing surfaces are sufficient to support a total weight of 70 tons on the bed slides. The uprights have a very broad base, enabling them to resist the back pressure of the heaviest cut, while the massive cross stay binds the whole structure together in a rigid and self-contained manner.

This immense machine might be expected to be cumbersome and difficult to work, but we are assured by the makers that it is easier to operate than some small

machines. This result is due to the very low pressure on the sliding surfaces, to the liberal use of ball-thrust washers, and to the provision of power motions in all directions. To insure easy manipulation the makers have introduced into the design their patented combined driving and feed gear box. This device gives power motions (*a*) for raising and lowering the cross slide; (*b*) for the quick movement of the tool boxes along the cross slide in either direction; (*c*) for the quick movement of the two vertical tool slides independently of each other; and (*d*) for raising the side tool boxes.

Variation in the length of the stroke is obtained by means of a circular disc with tappets, which can be easily changed while the machine is running if required. The change from feed to power motion is made by one movement of a lever. All the power motions can be operated from the front of the machine, including the movement of the two vertical slides on the cross slide, and of the side tool box at the back. Should the attendant be at the rear of the machine it is still within his power to engage the front motions at that point and to work from it.

The patented feed is positive, but the teeth are not under pressure at the moment of engaging or disengaging, so that there is no risk of their chipping at the points. The feed system engages without shock and covers a wide range of feeds which can easily be varied at any point of either the cutting or reversing stroke, and while the machine is running. In addition the feed system is provided with a direct reading indicator so that the desired feed can be set without difficulty and checked at a glance by the foreman in passing.

The bed of the machine has oil channels at each side with troughs at the end for waste oil. The table has square ledges to take the pressure arising from side cutting, and one of these ledges is fitted with an adjustable strip. The sliding face of the uprights is increased to the same width as the cross slide, so that satisfactory in-cutting is secured. The screws in the two uprights are cut accurately to the same pitch, in order that, when the cross slide is varied in height, it may retain its parallelism with the table. These screws are fitted with ball-thrust washers. The cross slide is long enough to allow either tool box to pass clear of the uprights and to plane the full width between them. The screws in the vertical tool slides have ball-thrust washers.

The driving of the machine is effected by an 80 brake horse-power motor reversing equipment working through gearing on to two separate steel "ball" wheels of large diameter, which engage with two separate forged steel racks with machine cut teeth of comparatively fine pitch. The cutting speeds range from 20ft. to 60ft. per minute, and the quick-return speeds from 80ft. to 120ft. per minute.

Railway Innovations in South Africa.

The South African Railway Department of the Government of the Union of South Africa has recently adopted several new systems for assisting country districts, not at present served by railway connections, to get their produce to a railway terminus and also to afford residents on farms in these out-of-the-way districts opportunities for visiting towns and so reducing the monotony of their lives. One of these systems is the Stronach-Dutton "road rail" system of light rail transport for which a trial line from Naboomspruit to a terminus on a farm named "Ceres," a distance of 20 miles, is nearly completed. This line is in the Transvaal Province on the Pretoria-Pietersburg section, and the experience gained will be valuable in determining to what extent this system is suited to South African conditions.

Another system of transport which is being exploited by the South African Railways is the rail motor.

On August 21st the Railway Department had a preliminary run with its new rail motor coach, intended for service on the Capetown–Malmesburg line. The coach, which is entirely of steel, was built by the J. G. Brill Company, of Philadelphia, and was assembled at the South African Railway's Salt River works. The power plant is a four-cylinder petrol engine designed for continuous running with heavy loads developing 68 horse-power at its maximum running speed of 1500 revolutions a minute. Malmesburg—49 miles from Capetown—was reached exactly two hours after the start, brief stoppages having been made at five stations *en route*. The petrol consumption was estimated at about 16 gallons for the 100 miles, and the average speed was 30 miles per hour. The whole journey with stops occupied four hours, which is 40 minutes less time than it takes the ordinary passenger train. The coach, which is very similar to a tramcar, is to be put into regular commission in September.

By far the most interesting experiment which the South African Railway Administration has tried, however, is a suction gas-electric locomotive which has been placed in service on the Kimberley–Winters Rush line. The history of the building of this locomotive, as told by Mr. C. Lawson, Superintendent (Mechanical), South African Railways, is not without interest.

Mr. Lawson, on being asked whether it would not be practicable to devise a motor vehicle which could use other fuel than petrol, saw no reason why carbon monoxide gas could not be utilised for this purpose, and sanction was given to him to make the experiment.

The general scheme was for a gas-electric locomotive on much the same lines as the Diesel-electric engines in use in Sweden. A pair of "Tilling-Stevens" high-speed petrol engines of suitable design, but rather limited power, were obtained from a whippet tank belonging to the Defence Department. The British General Electric Company lent a dynamo, and the De Beers Company (Kimberley) two tramway motors and control gear. The gas generator was built out of the smoke-box section of a sixth class engine boiler; a tank of curious dimensions, resurrected from the Pretoria scrap bank, was pressed into service as a scrubber, whilst a section of an ancient chimney served as an expansion chamber for the gas. These items were all assembled on an underframe, Salt River scrap bank being the contributor of this item. The underframe throughout was a nightmare. It had cross bearers and struts in exactly the position they were not required, and nothing where support for the engines and dynamo was required; in fact, worse than that, the cross bearers were invariably in the way of gas pipes, &c. After some alterations, the engine moved.

At this period of the experiment the machine had a wet scrubber, a dust collector, a 400-gallon circulating tank, and various other items which are used on stationary gas plants. Further tests showed that these things were not necessary, and they were one by one eliminated. A run was then made to Volkrust (167 miles), and the motors proved to be too small, so two 50 horse-power Siemens traction motors were obtained. Then the balance of power was in the other direction, the motors being able to take more power than the engines could generate. To meet this difficulty, a 120 horse-power "Holt" caterpillar tractor engine was borrowed. The equipment then consisted of a gas generator, scrubber, expansion chamber, "Holt" internal combustion engine, dynamo, resistances and two 50 horse-power traction motors, the current being controlled by two tramway series-parallel controllers, actuated in a similar manner to that of the ordinary electric tram. This is an accurate *résumé* of the evolution of the "Heath Robinson," the name given to it by the Electrical Superintendent.

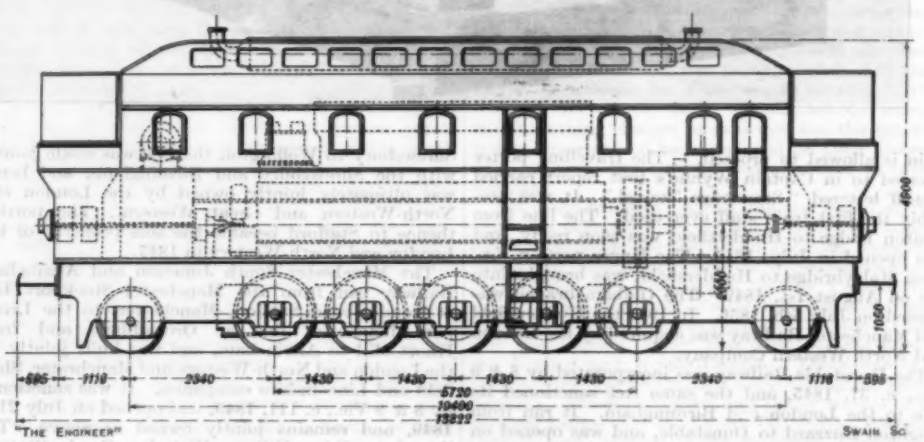
But it must be added that the internal combustion electric engine gives 30 per cent. efficiency, compared with the steam locomotive's 5 per cent. The present unit is anything but an ideal arrangement. The underframe is heavy, and consequently a good deal of deadweight is hauled. The engine weighs 32 tons, and hauls a 16-ton trailer. The horse-power available is 85, and the electric generator is overloaded even at that output. But it is fulfilling its purpose.

A Diesel-Electric Locomotive.

We are enabled to reproduce to-day a photograph—see p. 324—and a diagram of a Diesel-electric locomotive which has been constructed at the Esslingen Engine Works at Stuttgart, for Russia, and which will shortly undergo its tests. It is too early to give full particulars of this engine, but the following dimensions will give an idea of its size, and from the illustration a few obvious facts about its construction may be derived. It is built for the standard Russian gauge, which is practically 5ft., and is intended to run at a maximum speed of 50 kiloms. per hour. Its weight empty is 116½ tons, and in working order 125 tons. The adhesive load is 95 tons, and the driving wheels are practically 4ft. in diameter. The tractive effort is given as 15 tons.

The engine is of the M.A.N. four-cycle type, with six cylinders, 450 mm. by 420 mm., giving 1200 horse-power at 450 revolutions per minute. It drives a direct-current generator, which supplies five motors, one connected to each of the driving axles by 1 to 6.14 gearing. The tanks carry 4.5 tons of water and lubricating oil, and 4 tons of fuel oil. The electric equipment was supplied by Brown, Boveri and Co., of Baden.

The locomotive was designed by Professor George Lomonossoff—technical adviser on railway questions to the Russian Government—in collaboration with the Hohenzollern Locomotive Works at Düsseldorf. Owing to difficulties connected with the occupation of the Ruhr, however, the engine was not built at those works, but, by arrangement, at the Esslingen Engine Works, as stated above.



DIESEL-ELECTRIC LOCOMOTIVE

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

THE FIRST PUBLIC RAILWAY.

Sir,—If the question as to which was the first public railway be decided on national rather than on local grounds, then, surely, the Liverpool and Manchester is entitled to be so regarded, in preference to the Stockton and Darlington. The point is a mootable one.

There is, further, another reason for this distinction. The national idea of railways has, since the use of locomotives became a practicable proposition, always been associated with the working of the public lines, either wholly by locomotives or else partly by locomotives and partly by fixed engines. As shown in your tenth article—September 5th, page 261—the regular passenger service on the Liverpool and Manchester Railway, operated by locomotives, commenced on September 17th, 1830, whereas it was not, I believe, until September 7th, 1833, that locomotives were employed in that connection on the Stockton and Darlington line. On the day of the opening of that line, on September 27th, 1825, the engine, No. 1, Loco motion, hauled a number of people, who might more strictly be called sightseers than passengers in the usually accepted sense. Thereafter, until September, 1833, the passenger traffic was conducted by means of horses, the locomotives having meanwhile been confined to the working of goods and minerals. In the latter respect, the Stockton and Darlington Railway came first, of course, as similar traffic was not conveyed publicly on the Liverpool and Manchester until December 14th, 1830.

William James having been the original projector of the Liverpool and Manchester, your leading article on "The Father of Railways," in the same issue of your journal—September 5th—in which you argue in favour of James's right to the title, is, therefore, of more than passing interest. From the standpoint of national utility and importance, that line must, I think, take precedence over its earlier rival, which was for many years almost entirely a coal-carrying concern. On the other hand, the comparative success of the Stockton and Darlington undoubtedly helped to expedite the fulfilment of the Liverpool and Manchester scheme, which, in its turn, led to the further development of the locomotive itself.

F. W. Brewer.

Stevenage, Herts., September 15th.

THE NUNEATON OMNIBUS DISASTER.

Sir,—Now that the public has had a little time to consider the various opinions and suggestions in connection with the above-named disaster, and before it is forgotten, I venture to submit the following points for consideration.

My object in writing is to emphasise the very great danger of constructing these public vehicles of highly inflammable material, such as three-ply wood, more particularly the closed type of omnibus such as the one under consideration. There is no reason why these vehicles should not be almost entirely constructed of fireproof materials, *i.e.*, thin metal and asbestos for the roof and sides, and corrugated steel and fireproof composition for the floors, which is light, cheap and strong, thoroughly hygienic, comfortable and easily kept clean. The windows should, of course, be made to open easily; frameless windows are extensively used in motor car construction. They slide in side channels and require no strap to operate them, but can be pushed up and down and remain in any position; they can be opened immediately.

In wooden vehicles the framework around the petrol tank becomes saturated with spirit and takes fire very readily, burning fiercely and quickly spreading to the surrounding woodwork.

The problem of fireproof construction of railway carriages and other public vehicles was receiving considerable attention before the war, but there appears now to be a reversion to wooden construction, and it is deplorable that disasters of this character, resulting in serious loss of life with great suffering, appear to be necessary to bring the matter into prominence. A very large number of railway carriages are now being built to replace the shortage caused by the war, and the great majority are entirely lacking in any fireproof protection for the passengers, with the result that when a collision or derailment occurs, it may result in serious loss of life by fire, as on previous occasions.

London, September 12th. A.M.I.C.E.

EDUCATIONAL INTELLIGENCE.

The education officer of the London County Council has sent us a copy of a booklet which has been published in order to acquaint the public of London with the facilities for continued education which are offered by the many institutions aided and maintained by the Council. It gives a concise account of the provision made for continuation education of all types—commercial, technical, trade, domestic, literary and of the facilities which are available for all classes of students for improving their knowledge and using profitably their leisure hours. We have also received from the London County Council particulars of their classes for commercial instruction and from the Royal Society of Arts particulars of its commercial examinations.

Institution of Production Engineers' Annual Dinner.—At the Engineers' Club on Saturday, September 13th, there was an interesting gathering of production men. About 100 members of the Institution of Production Engineers and their guests assembled for the fourth general meeting, when the president for the forthcoming session, Mr. W. L. Fisher, presented his address. A very enjoyable dinner followed. The president put forward a plea for further backing for the Institution by engineering firms, pointing out that it was doing great co-educational work amongst production men, and that the efficiency of their work was much increased thereby.

Railway Matters.

BECAUSE of the inconvenience caused to the travelling public by the consequent closing of Charing Cross Station, a minor collision near London Bridge Station on Saturday afternoon last has received undue prominence. The mishap was caused by a light engine running into a train of empty carriages.

FOR the construction of the Kennington Loop—the new under-the-river connection of the London Electric Railways—four shafts have been sunk. Those nearest the river are one off Villiers street and one at Waterloo. At Bethlehem Hospital the shaft is in duplicate, while at Waterloo headings are being driven in both directions. This work was the subject of a note in our Journal page on July 11th last.

THE Colombian Government is considering a scheme, drawn up by a local syndicate and supported by foreign capital, for the construction of a funicular railway connecting the town of San José de Cúcuta with Ocaña and the Magdelena River, in the Department del Norte de Santander. It is expected that a favourable decision upon the part of the Ministry of Public Works will be given shortly, following which construction will at once be put in hand.

IN an article urging greater electrification of the lines in the Manchester area, the *Manchester Guardian* recently said that the electric trains from Victoria Station to Bury stop seven times in 9¼ miles, but do the journey in 20 minutes, or at the rate of 28¼ miles per hour. The steam trains to Altrincham stop seven times in 8¼ miles, but only travel at 17¼ miles per hour. To travel to Bacup one goes to Bury, 9¼ miles, by electric train in 20 minutes, but it takes 50 minutes to cover the remaining 12¼ miles.

AFTER being on strike since August 9th, the members of the Workers' Union of Ireland, employed at the Inchicore Works of the Great Southern and Western Railway, resumed work unconditionally on Monday. Their leader came over to England a week or two ago hoping to get support, but to the credit of the trades unions, they would do nothing that would jeopardise industrial peace in Ireland at this time. It is significant that the men were on strike because of a disagreement with another trades union as to the allotment of work.

IN connection with the plan now being studied for the construction of a metropolitan railway at Brussels, M. Max, the mayor, stated recently that in the construction of the line existing works on the expropriated land would be utilised as far as possible. The railway would start from the Gare du Midi and run to the old quarter of the Putterie, where the central station would occupy the site which had been intended for another railway. From that point two lines would start, one towards the Gare du Nord and the other towards the Gare du Luxemburg. These three principal stations would thus be linked up.

WE regret to have to record the death at the advanced age of ninety-seven of Mr. Richard Johnson, the *doyen* of railway engineers. Mr. Johnson may be said to have been a part of the Great Northern Railway, as he joined it in its early days, and was the chief engineer from 1861 to 1897, when he retired and was succeeded by the late Mr. Alexander Ross, at that time chief engineer of the then Manchester, Sheffield and Lincolnshire Railway. The very difficult lines built by the Great Northern in Derbyshire, Notts. and the West Riding of Yorkshire in the late 'seventies and early 'eighties, and the later widenings approaching King's Cross, will ever be memorials to Mr. Johnson's thoroughness in his work.

A VERY serious situation has arisen over the rejection by a special committee of the Legislative Assembly of India of the proposals for separating the expenditure on the railways from the general finance of the country. The Indian railways, have, for years, been starved because each year's finance has had to stand alone, e.g., certain sums were allotted for works, and if those works were not finished by the end of the financial year, the available balance was not carried forward but lapsed and had again to be voted. Such financial arrangements are extravagant and unsatisfactory, and it is difficult for the officials to work with zest when each year sees the programme open to revision. The outstanding feature of the report of the Acworth Committee was that the railways should be more "on their own." The rejection of the proposals is, apparently, the work of the Indian members, who seek to Indianise the services and who fear that the Government may continue the company-management of some of the lines. Later cables state that the committee which has been dealing with this question has reconsidered its decision, and that the scheme is now likely to go through with substantial modifications tending to increase the amount of the contribution of the railways to the general revenue.

THE month of September has been, in the matter of railway accidents, the worst for British railways. Tuesday last was the anniversary of the Westhorpe disaster of 1887, when a collision occurred between two trains going to Doncaster for the St. Leger. The Manchester, Sheffield and Lincolnshire dealt with the additional traffic by suspending the block system and having hand signalmen. A Manchester, Sheffield and Lincolnshire special ran by the "danger" hand signal that protected a Midland special, and twenty-five passengers were killed. Last Wednesday it was twelve years since the Ditton derailment. In that case a driver with insufficient knowledge of the road proceeded with the same full speed on to a slow line that he would have taken had he been going along the fast line. He and his fireman and thirteen passengers were killed. A fire broke out in the wreckage. To-day is the eighteenth anniversary of the Grantham disaster—the first of four serious accidents where drivers overran signals under conditions that could not be accounted for, and in which, as the enginemen were killed, no explanation was forthcoming. The signals at two boxes were ignored at Grantham, and the junction at the second box being made for a minor line which opens with a sharp reverse curve, the train was derailed and twelve passengers, a postal official and the driver and fireman were killed.

Notes and Memoranda.

A CONVENIENT method of imparting the blue finish, such as is given to the handles of pliers, &c., is to immerse the articles in a bath of melted saltpetre, allowing them to remain in the bath till they are heated to the same temperature, and then quench them.

A NEW substance of the synthetic resin type, which has been given the trade name of Pollopas, and is a substitute for glass, is being manufactured in Vienna. It should, it is said, be suitable for optical instruments and for replacing fused quartz as an ultra-violet ray filter. Its electrical resistance qualities are not very satisfactory, but it is hoped to make improvements in this direction.

SOME extensive tests have recently been made by the American Bureau of Standards on the compressive strength of iron ore from the Birmingham (Alabama) district. A portion of these tests was made in the usual manner, while in others the specimens were subjected to vibration during the test. The strengths obtained varied from 10,000 lb. to 17,000 lb. per square inch. No appreciable reduction in strength was observed because of the vibrations.

THE port of Casablanca, Morocco, which was begun in 1913, is now approaching completion in its most arduous part. The massive grand jetty, which is to extend for 2050 m., is nearly finished, while the transversal jetty has advanced over 860 m. out of the 1600 m. of its projected length. Already the 150 acres of water space are fully protected in all weathers Two to three steamers can now lie alongside the grand jetty simultaneously and passengers can be landed direct on to the quay.

FIGURES obtained by the American Bureau of Mines from a well-drilling company which has conducted a complete time-lost study of oil-well drilling in six of its wells, show that in rotary drilling only 31.2 to 36.54 per cent. of the total time to bring in a well was spent in actual drilling, and that 21.5 to 29.3 per cent. of the total time, amounting in one instance to 250 hours, was spent in pulling-out and running-in to change bits. In cable tool drilling 37.4 to 54.13 per cent. of the total time was spent in actually drilling and only 1.49 to 2.94 per cent. was spent in changing dull bits

DURING July the Government Areas of the Transvaal goldfields achieved four distinct records in respect of tonnage milled, value of gold produced, working costs per ton, and profit earned. The ore milled at 165,000 tons exceeded the previous "best" tonnage stamped and treated (in May of this year) by 5500 tons, and the total revenue at £338,120 for July was nearly £3000 better than the revenue for June. The cost per ton last month was 16s. 7d., which is 1s. per ton below the cost for June and 9d. better than in May, whilst the profit at £206,289 exceeds the previous best earning (again in May of this year) by over £9000.

AN investigation is being made, according to the *Canadian Engineer*, by the Ontario Hydro-Electric Power Commission of a proposal made by Mr. Ralph Keemle, of Chatham, Ont., that the waters of the Ogoki and Albany rivers be diverted from Hudson Bay into Lake Superior. His suggestion is that by a judicious placing of dams on these rivers at the height of land north of Lake Superior, the flow of water from a watershed some 20,000 square miles in area might be diverted into the Great Lakes, with the resultant raising of the level of the St. Lawrence waterway from 1ft. to 18in. This would, it is claimed, more than counteract the damage to the St. Lawrence by the Chicago drainage canal.

AN interesting piece of work was recently carried out at the Marehay Colliery, owned by the Butterley Company, Limited, and is briefly described in the *Iron and Coal Trades Review*. This colliery, which is situated near Ripley, in Derbyshire, has an output of between 400 and 500 tons per day. On a Friday evening winding finished at the end of the afternoon shift, when the headgear was taken away bodily and replaced by an all-steel headgear with new pulleys, the whole being carried out during the week-end. Winding commenced again as usual at 7 a.m. on Monday morning, and was continued without any interruption. The headgear was built and erected by the Butterley Company, Limited, and was removed bodily into position during the Sunday.

THE cost of copper in Germany has prompted the machine-tool makers to search for alloys with a low copper content. Extensive experiments with six different alloys have been made in Berlin with both sand and chilled castings. It was found that neither the pressure in the bearing nor its running temperature was the decisive factor in determining the life of a brass. Contrary to the expectation of the shop experts, the bushes cast on sand cores were distinctly better than those cast on iron cores. When broken, these bushes showed that the structure of the fractures was not very different for the two ways of casting. The conclusion reached was that bushes with a high zinc content ought to be cast on sand cores and lubricated with a good oil. They were found to expand more than do bronze bushes, and need a little extra play for the axle. It is to be noted that the actual proportion of copper to zinc has not been disclosed in the continental technical Press.

IN the new steam retort, which has been made for experimental purposes by the American Bureau of Mines, the material to be retorted is fed downward through the retort and superheated steam at a temperature of about 1200 deg. Fah. is admitted at the bottom. Bins are so arranged at the top and bottom of the retort that the process can be made continuous, and the feed mechanism is so controlled that it is possible to have a range of passage of material through the retort of from 15 lb. to 50 lb. per hour. A heat recovery scheme has been provided for recovering the heat from the spent shale. The superheater used in connection with the retort has a capacity of about 30 lb. of steam per hour from 210 deg. Fah. to 1300 deg. Fah. The steam and oil vapours leave the retort at about 300 deg. Fah. In order to control operating conditions and to show transfer of heat through the retorted material, ten base metal thermocouples were placed throughout the length of the retort, superheater, and superheater combustion chamber.

Miscellanea.

THE Canadian copper output for 1923 amounted to 86,885,370 lb., as compared with 42,899,818 lb. in 1922.

A LARGE wood-pulp industry is to be established in North-West Tasmania with an initial expenditure of £325,000.

THE Eston Urban Council is opposing the proposed construction of a bridge across the Tees at Newport, and advocates a tunnel further to the east.

THE proposed closing down of the Avonmouth Spelter Works, which was to have taken place at the end of August, has been postponed indefinitely.

IT is proposed that the Glasgow Corporation should purchase the tunnel under the Clyde, and, in its place, build a bridge between Finnieston and Mavisbank.

THE discovery of an extensive graphite deposit is reported from Morelia, in the Chaco district of Mexico. It is estimated that a daily production of 5 tons is easily possible.

THE first five units of the Queenston–Chippewa power plant at Niagara Falls are operating and loaded to capacity and the Commission is installing three additional generating units.

THE Wallasey Council has decided to proceed with the scheme for providing a floating roadway for the goods traffic at Seacombe Ferry. The scheme will cost between £80,000 and £100,000.

THE Royal Commission on Mining Subsidence proposes to visit Scotland on October 16th and 17th to obtain by personal inspection of typical cases direct evidence of the damage caused by mining subsidence.

THE cost of the proposed harbour works at Gisborne, New Zealand, is put at £750,000. It was originally intended to provide a depth of water of 25ft., but this has been reduced to 18ft. for the time being.

IT is reported that wireless transmitting apparatus is to be installed in all lighthouses on the British coast. A skilled operator will be put in charge, whose duty it will be to warn ships at sea of impending danger.

WORK is about to be started on dredging the Clyde opposite Princes Pier. The work will involve dredging 500,000 cubic yards of material, which will be dumped between Portkil and Kempoch Points, and may require five years to complete.

A NEW petroleum products store which has been constructed near Bowling will enable petrol to be imported to the Clyde in bulk for the first time. The tanks have a capacity of 2½ million gallons and there are also fuel oil tanks capable of holding 20,000 tons of oil.

DURING 1923 the total quantity of gas sold by the Sheffield Gas Company was 4,358,516,000 cubic feet, an increase over 1922 of 219,923,000ft.—or 5.31 per cent. The average price of gas sold was 2s. 9.77d., compared with 3s. 3.07d. per 1000 cubic feet in 1922.

THE Ontario Hydro-Electric Commission has put into service the third unit of the Nipigon plant, which brings up the capacity of the station to 37,500 horse-power. A fourth unit is to be started this month, when the output will be increased to 50,000 horse-power.

THE old Telford Glassford Bridge across the river Avon in Lanarkshire collapsed on the evening of September 9th. It appears that a recent spate undermined the clay foundations of the centre pier, which, in sinking, loosened the keystones and the arches consequently fell. The bridge was built in 1826, and was approximately 100ft. in length, in two arches.

A MESSAGE from Stockholm states that the Swedish company, Eriksbergs Mekaniska Verkstads Aktiebolaget, has obtained an order for the reconstruction of the steamer Temis, owned by the Nornan Shipping Company, of Gothenburg. This reconstruction work will be noteworthy, as it involves the lengthening of the hull of the steamer by about 16ft., and simultaneously extending the quarter deck to the fore hatchway. The capacity of the steamer will be increased by 10,000 cubic metres to 45,000, and the burthen by 165 tons.

THE bridge which it is proposed to build across the George's River, New South Wales, will consist of six steel truss spans each of 225ft., and three steel plate girder approach spans each of 89ft. 3in., making a total length of 1640ft. overall. The girders will rest on reinforced concrete piers and masonry abutments with easy graded approaches on either side, that on the Sylvania side being faced with stone pitching. The bridge is designed to carry electric trams and 20-ton lorries, and, in addition, a distributed live load of 70 lb. per square foot on the carriage-way and 50 lb. per square foot on the footway.

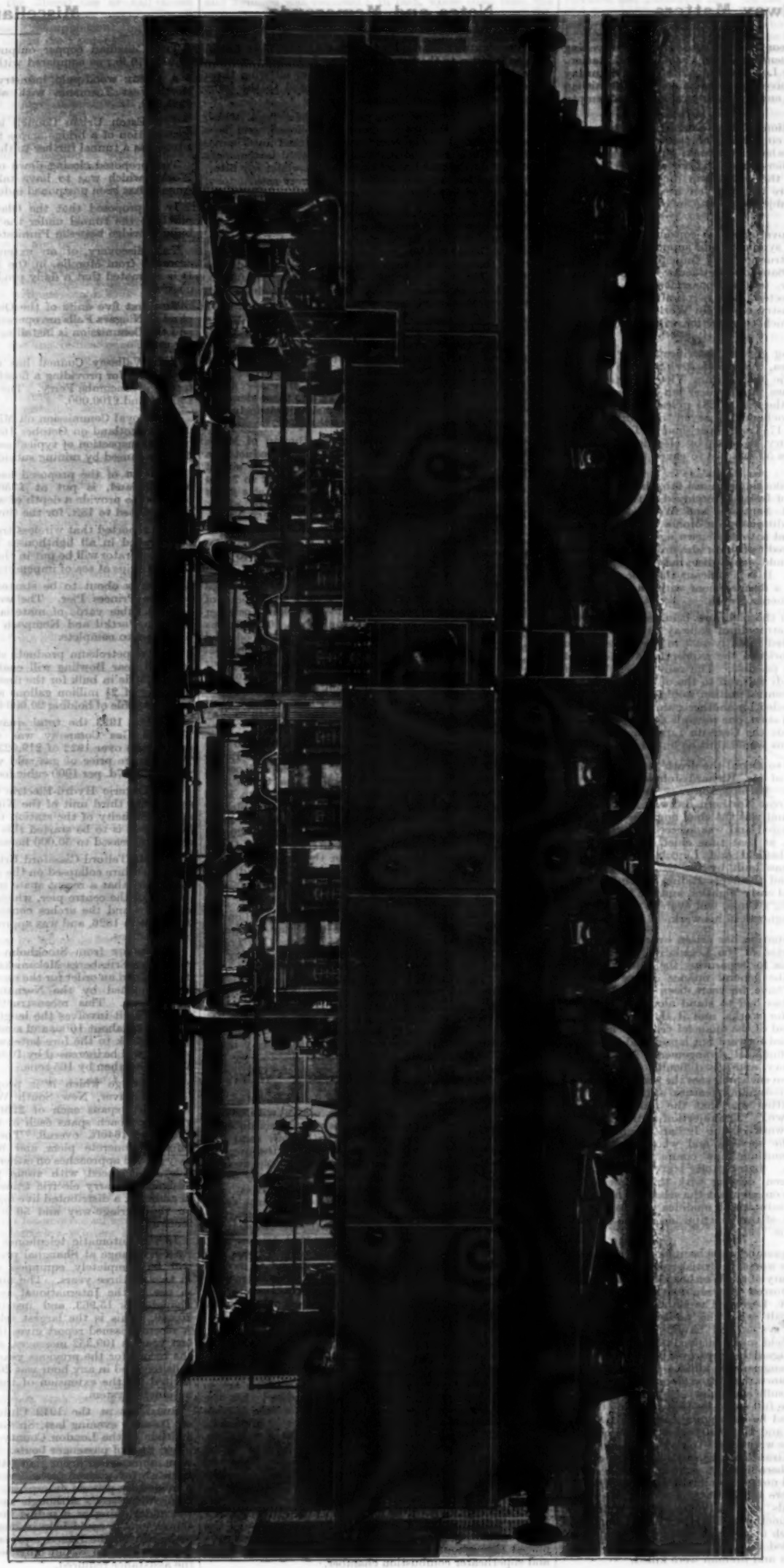
IF the automatic telephones recently installed in the East Exchange at Shanghai prove satisfactory, Shanghai will be completely equipped with similar instruments in two or three years. The number of direct lines now in use in the International and French Concessions of Shanghai is 15,963, and instruments installed number 20,640. This is the largest telephone system in China. A recently issued report gives the record for a single day last year as 199,352 messages, an increase of 11,528 over the record for the previous year. The largest number of calls received in any hour was 20,365. Tenders have been invited for the extension of the central exchange to the automatic system.

SPEAKING at the 1912 Club, Bucklersbury, London, on Tuesday evening last, Sir Geo. Hulme referred to the attitude of the London County Council towards the proposed fleet of passenger boats. The Council, he said, had been approached from more than one quarter to give facilities for a river passenger service, which was to be provided by private enterprise. The proposals were now being discussed. Although the Council would not run the undertaking as a public body, if by making certain concessions it could help in enabling a passenger service to be run on the river by private enterprise, he thought that the Council would only be doing its duty in giving the assistance required.

DIESEL-ELECTRIC LOCOMOTIVE FOR RUSSIA

HOHENZOLLERN LOCOMOTIVE WORKS, DÜSSELDORF, ENGINEERS

(For description see page 322)



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THE ENGINEER.

SEPTEMBER 19, 1924.

The Education and Training of Engineers.

THE last general conference on the training of engineers was held in 1911 at the Institution of Civil Engineers. Since then no attempt has been made to examine the results achieved by the methods adopted as a consequence of that conference. Public interest in the subject has apparently died down, and the lively discussions which filled meeting halls and the columns of the technical and lay Press a dozen years ago have almost ceased to exist. Occasional speeches are, indeed, heard, and now and then a paper or an article on engineering schools is met with; but, on the whole, the system of training has been allowed to pursue its way without any examination of its effectiveness by the engineering profession or industry. Now, there are very few human institutions which do not require frequent revision, and technical education is assuredly not one of them. Engineering in all its branches is essentially progressive. It changes rapidly, not only by the introduction of new inventions and new methods, but also as a consequence of "trade" conditions, as, for example, through the coming of mass production and specialisation. Civil engineering has perhaps not changed very greatly since 1911, but mechanical engineering—with which the bulk of electrical engineering may be included—is very different from what it was in that year. If we turn from the practical and executive side to the scientific side we find even more pronounced developments. The subjects with which the student is expected to have some familiarity are more numerous and more complicated than they were thirteen years ago, and the inclusion of them all in curricula of reasonable length becomes more difficult as the years pass by. For these and many other reasons it would seem that the time is ripe for a general review of the position and for a close examination of the results which are being achieved by our technical colleges and by our system of practical training. We suggest, therefore, that our greater institutions should convene a conference for the reconsideration of the whole matter.

One of the prime subjects which would come up for discussion at such a conference is the nature of the education which is now given in our technical colleges and universities. It may be said, broadly, that there are two schools of thought. The advocates of one hold that the first duty of the teaching institution is to lay a firm foundation of established principles upon which the student, when the time comes, may raise whatever superstructure he desires. The advocates of the other insist that the education should be as wide and far-reaching as possible. They would not lay exceptional attention on the foundations of science, but would make it their object to give students an outline of many branches of science and technology and to present to them the very latest developments of scientific thought. There is much to be said in favour of both plans, but we incline to the view that, whilst the second is appropriate enough in a university, where a good deal of picking and choosing is permitted to the student, the former is the more desirable in a technical college in which the students are required to attend specified lectures and classes. It may be said that the larger method produces broader men, men with wider interests, more intellectual men. It probably does, but in so doing it neglects in some degree that radical groundwork of science on which such wider knowledge must be founded. We can imagine a man so trained being able to follow the latest discussion on the nature of electricity and yet being incapable of handling the elementary laws of physics. We hesitate to say so, but the outcome of such education may be the production of the dilettante and the smatterer—a very good man for the meetings of the British Association, but an indifferent one for the office or the factory. There is always the danger of attempting too much and thereby stultifying the whole. Recently we were shown a paper set at an important examination for young mechanical engineers. It was on concrete and required a far more intimate knowledge of the chemistry of cement than should be expected in a mechanical engineering student. The fact that that paper was included in the examination caused many hours of work to be devoted to a subject which might quite well have been omitted. What was the consequence? That the student was obliged to hurry over other subjects with which his familiarity should have been perfect. That is but a single case out of several, all of which tend to show that with the advancement of science the number of subjects included in curricula has increased until a point has been reached where it is practically impossible for any, save very exceptional, students to cover them all. There is evidence from many parts of the country that students are weak in the elements and that their knowledge is frequently of the kind that will carry them through examinations, but fails when it is put to practical tests. It is, by now, common knowledge that the Institution of Mechanical Engineers, through the National Certificates, has done something already to check a bad tendency, and we may express a hope that it will continue to press for "solid foundations." That is one of the subjects that would demand the attention of the conference. Another of considerable importance is the relationship between the public schools and the technical colleges. Two classes of youths now enter these colleges, one drawn from the secondary schools and the other from the public schools. Those of the first class are generally selected boys who have shown a particular aptitude for mathematics, science and examination, whilst those of the second are the ordinary product of the public school. They have had no more specialised training than the "modern side" can give, and as a whole they are distinctly weak in mathematics and their science is barely worthy of the name. Relatively few of them are able to keep pace with the boys who have already received some specialised education in secondary schools. The problem presented is a difficult one to handle and delicate to discuss. But it is, we think, admitted, even in these democratic days, that the public school boy does acquire certain qualities which are valuable in after life. For that reason, if for no other, his position in technical colleges requires very careful consideration. The question is one that the conference would find it hard to solve, but it is possible that the headmasters of public schools, were they invited to attend, might be able to make useful suggestions or show themselves willing to entertain modifications of their curricula which would better meet the conditions than those which now prevail. Such hopes are encouraged by the fact that one or two of the public schools have adopted schemes of scientific and mathematical education which leave little to be desired.

Of the many other matters connected with the training of engineers which would come before the conference we have no space at the present to write. Nor can we now discuss the not less important question of apprenticeship, on which there is, unfortunately, some division of opinion, some holding with the French that manual work is unnecessary, whilst others, fortunately in the majority, believe firmly that an engineer cannot be made without actual workshop experience at

the bench and the machine. Another matter of no little moment is the great expenditure involved in the upkeep and housing of the fine collection of engines and machines that may be found in many colleges. There is reason to doubt that these costly equipments justify their existence. Had we space to allude in greater detail to such interesting problems as these, we could make it manifest that there is more than enough material to occupy the time of a conference for several days, and that it is all of a kind that demands attention with increasing urgency.

Aluminium Bronze.

In his autumn lecture to the Institute of Metals Mr. W. M. Corse, a well-known American metallurgist, gave an interesting account of the development which has taken place in America in the uses of aluminium bronze. By this term he understands—as most people do—not a brass or bronze containing a small addition of aluminium, but the "straight" alloy of copper with 8 or 10 per cent. of aluminium, to which in some cases a little of either lead or iron may be intentionally added. Mr. Corse paid tribute to the fact that the most important fundamental investigation of these alloys had been carried out in this country for the Alloys Research Committee of the Institution of Mechanical Engineers, and had been published in its eighth and ninth reports. The commercial development, however, has been almost exclusively American, so that an English audience was surprised to hear of the varied and important uses to which these materials are being put. Among these uses may be mentioned the worm gear wheels of one of the Ford lorries, which have been produced in many thousands. In addition the alloy is used for numerous minor, but none the less important fittings on many American motor cars, and also in electrical switchgear.

All this development, which Mr. Corse evidently regards as a mere beginning, appears to be the result of the efforts of one or at most two American firms, which have made a speciality of these alloys. In the early stages they were assisted by the researches of Messrs. Curry, Comstock and Corse himself in arriving at the best commercially suitable alloy of the group, but the original basis is undoubtedly the British work on the subject. The position in England is, unhappily, strongly in contrast with that in America. One would have thought, at first sight, that British research would most naturally find its readiest application in England, that our metallurgical manufacturers would be readily alive to results produced and published in their midst, and even to some extent with their own co-operation, and that their resources and facilities for developing a new alloy would be sufficient to enable them to take full and early advantage of the new knowledge placed before them. Yet, in this particular case, this has not happened. At the present time, there is no British firm producing these aluminium bronze alloys as a regular part of its output, and anyone desiring parts made of this material, either fails to obtain them or is asked to pay a high price for a "special" article. Unfortunately, aluminium bronze, although a striking instance, is by no means an isolated example of the way in which research results of very real commercial value which are produced in this country are here neglected and their development and exploitation left to others. The reason for this state of affairs is not very easy to understand, since it is probably a complicated one. The mere charge of lethargy and lack of enterprise against the whole body of our manufacturers could hardly be sustained, and one must look somewhat further. Conservatism—the fear of entering upon a new and necessarily untried field—no doubt has something to do with the attitude which is so frequently taken up. The desire seems to be to extend and develop existing lines of business rather than to spend time and money and effort on new developments. While natural enough in a business organisation looking for immediate financial returns for every penny spent, the ultimate results are most unfortunate for the future of our industries. We have seen it over and over again—in dyes, in fine chemical manufacture, in glass and in light aluminium alloys. We are seeing it again in the aluminium bronzes, and the story is likely to be repeated unless a better realisation of the ultimate importance of new developments can be instilled into our manufacturers. One of the difficulties which has to be overcome is, we fear, a decided lack of confidence on the part of the practical man in the results and data of what he calls "academic" or laboratory research. He looks upon the products of the laboratory as interesting and possibly amusing "toys" which have little relation to works requirements—"what can be done in the laboratory cannot be done in the works" is one of the favourite catchwords, with which the continued neglect of research results is apt to be justified. Now, we would not for a moment underestimate the difficulties of translating into industrial practice the results of research; the difficulties are in many ways as great as those which the research worker himself has to overcome in his laboratory because, it must be remembered, it is also true that what can be done in a works can only rarely be done in a laboratory. The intermediate steps, from the research laboratory to industrial production, are often difficult and costly. Yet the transition has often been accomplished even in this country—unhappily, it is more frequently being accomplished abroad. We have, at the present time, excellent facilities and organisations for research; our metallurgical researchers are, admittedly, the world's leaders in this field. Yet the benefit to our industries is but a tithe of what it might be for want of application of our research results to industrial practice. We see other countries reaping the benefit of our research work. We cannot hope to prevent them from doing so unless we ourselves make the necessary effort. If we do not, the money and labour spent on research, at all events so far as its direct practical bearings are concerned, will be in great part lost.

This lack of real confidence in the results of research goes perhaps even deeper than at first sight may appear. A new product of any kind, or even a marked improvement in an old one, rarely finds its market ready-made. The manufacturer who wishes to succeed with such a product must first educate the consumer up to its use and value. This entails much spade work in the way of skilfully conducted propaganda and publicity. The natural caution, conservatism—inertia, even—of the engineering world has to be overcome, and a campaign for such a purpose can only succeed if it is backed by real faith or conviction that the new product is all that is being claimed for it. The market, in fact, has to be made for it, and this task can only be undertaken successfully by men who are themselves keenly appreciative of the value of what they are trying to "push." It would seem, then, that one of the barriers to our industrial advancement along the lines of research lies in the gap which still exists between the research worker and the manufacturer. A better mutual understanding and appreciation is needed, and, above all, a recognition of two facts—one, that laboratory researches cannot be expected to yield results which can be utilised in practice without a great deal of further and very difficult work; and, two, that the results of laboratory research must be made as readily available and comprehensible to the practical man as the nature of the case allows.

The Institute of Metals.

No. II.*

The autumn meeting of the Institute of Metals was resumed in the hall of the Institution of Mechanical Engineers on September 10th, Professor Thomas Turner, president, in the chair.

Mr. Douglas H. Ingall presented a paper dealing with "The Relationship between Tensile Strength, Temperature, and Cold Work in Some Pure Metals and Single Solid Solutions." An abstract of the paper is appended.

TENSILE STRENGTH AND TEMPERATURE.

The tensile strengths of annealed and hardened wires of aluminium, silver, nickel, 70/30 brass and 80/20 cupro-nickel at various temperatures were determined by the constant load and rising temperature method. In all cases a fundamental relationship was found with regard to tensile strength and temperature (previously shown with copper), which is expressed by a straight line up to a critical inflection temperature, and by a curved line for higher temperatures. The straight line portion of the curves may be expressed by the formula $Y = a - bX$, where Y = tensile strength, X = temperature, and a and b are constants. A common relationship between the constants a and b and a common limiting value of X (critical inflection temperature), both expressed in terms of the melting point, has been found for pure metals in the soft annealed state, which would make the straight-line portion of the curve fundamental in these cases. It is suggested that the critical inflection temperature is the all-important property of any metal or alloy for high-temperature service, as it would appear to be the temperature above which viscous flow may take place, and below which there is only stability of the material in the cold worked state. Other things being equal, the higher the critical inflection temperature, the more suitable is the material, and in this respect the experiments indicate that alloys of nickel or any other metal of high melting point, which form a continuous series of solid solutions with a high temperature liquidus, should prove to appear to the best advantage.

Dr. Thompson said the contribution was not without interest on the practical side, but the interpretation of the results obtained was somewhat difficult. Until now there had been a tendency in work of this kind to smooth out the curves obtained, but it was now evident that the subject was more complex than had been imagined. He congratulated the author on having shown courage, and he had certainly produced justification for the new form of curve. It had been thought that after the annealing of cold-worked material there was a simple relationship between tensile strength and temperature, and the author had done great service by the proof he had given that it would be necessary to revise that opinion. The point of interest for engineers was that if materials were to be subjected to long continued static stress the maximum permissible stress was given by what the author termed the "critical inflection temperature."

Mr. Martin could not accept the statement that 175 deg. was a critical temperature of aluminium, in which the real change occurred at 300 deg. The paper was, however, an important contribution, particularly when examined in the light of the work of Dr. Carpenter, Dickinson and others. The effect of the various researches which had been carried out was to render it doubtful whether the tensile test as ordinarily made was of much use in tests at high temperature as an indication of true tensile strength, and another method of testing at these temperatures might be necessary. It was desirable to ascertain the effect of the time factor at high temperatures and the range of load over wide limits before it could be decided what was the real result of tests carried out in a testing machine.

Dr. W. Rosenhain dealt with the paper from a rather more critical standpoint. It was necessary, he said, in putting forward new points on the curve showing the relationship which was the object of the author's work to be certain that all possible sources of experimental error had been eliminated. The research described by Mr. Ingall was an attempt to ascertain the lowest temperature at which changes of properties were revealed in cold-worked material when heated at specific rates under stress. All other experiments in the same field had been carried out with the metals released from external loading. The fact must be borne in mind in looking at the results obtained. He would also point out that in experiments of this kind the rate of heating was of great importance and that a change in the rate might have considerable influence on the results. He suggested that the author had perhaps gone too far in his deductions and in his attempt to apply them to actual engineering. What the engineer desired to know was not the stress the materials he employed would withstand for a few minutes, but what was the capacity of the material over a long period. The extent to which cold-rolled material could be relied upon under high-temperature conditions was a subject on which more information was undoubtedly needed. Materials had to be exposed to fatigue stresses at high temperatures in, for example, the connecting-rods of internal combustion engines. Recent investigations on the effect of alternating stresses suggested that the process of fatigue was not unconnected with the class of phenomena which occurred in cold work. That consideration gave Mr. Ingall's research an interesting bearing. There was opened up the possibility of determining the temperatures at which the cold work effect would not be deleterious and indeed might give an improved material.

Mr. Barclay welcomed the account of this investigation as opening up to the practical man a fine field in which to exercise his imagination. The question of the electrical properties of the materials should be taken into consideration. He believed it would be found that these properties underwent a considerable change when wires were exposed to stresses either in tension or compression at temperatures of 400 deg. and upwards. More knowledge of the mechanism of cold work on such materials as wire was required.

Dr. H. Moore expressed the opinion that the method used by Mr. Ingall could be developed for a general survey of the changes in the properties of metals with rising temperatures.

Mr. Ingall, in concluding the discussion, agreed that the rate of increase of temperature as a factor which should be taken into account. He had compared in a general way the curves he had obtained with high-temperature curves obtained by other workers and had found general agreement. The suggestion had been made that his method of investigation might possibly be used to reveal an increase of strength in materials at definite high temperatures. A change in properties of that character would be shown in a general way.

Professor Turner, in moving a vote of thanks to the author, said that some years ago an account had been given to the Institute of the general connection between tensile strength and temperature on worked and unworked material. Mr. Ingall had continued the work with other metals and wider ranges of temperature, and had opened up a field of inquiry which had aroused great interest.

A note was brought up by Dr. Harold Moore "On the Effect of Progressive Cold Rolling on the Brinell Hardness of Copper." An abstract follows.

THE BRINELL HARDNESS OF COPPER.

In a paper recently published by Rawdon and Mutchler, of the Bureau of Standards, U.S.A., it is stated that in the cold

* No. I. appeared September 12th, 1924.

rolling of copper, iron, tin and other metals and alloys, the Brinell hardness rose rapidly during the initial stages of deformation and then diminished; "the metal becomes softer and in its final form may be softer than the metal in its initial stage." Experiments have been carried out at the Research Department, Woolwich, to test this surprising conclusion. An annealed copper bar was cold rolled from 3.12in. to 0.0125in. thickness, one-half of the material being withdrawn for testing after each reduction of 50 per cent. of the thickness. The Brinell hardness number was 48 in the annealed bar, 98 after the first reduction of 50 per cent., rose at each subsequent reduction, and reached 130 when the thickness was reduced to one-two hundred and fiftieth of the original thickness. Balls of 5 mm., 2 mm., 1 mm. and 0.8 mm. diameter were used in the Brinell hardness tests, care being taken in testing the thinner strips to avoid error arising from the use of too large a ball and load. The results give no support to the suggestion that severe cold-rolling of copper beyond a certain stage induces softening, and the author considers that convincing evidence of any such effect occurring generally in metals and alloys is still lacking.

Dr. F. Johnson suggested that the cold work done might affect the Brinell figures indicating the hardness of the whole mass. It was interesting to note that Dr. Moore had taken the time factor into consideration. He had himself found in the case of Armco iron that different hardness results were obtained by taking the tests at different times after the application of the work. After two hours the figure was 41.3, after two days 43, and after twelve days 44.5, results which justified Dr. Moore's precaution in carrying out his experiments in a short period of time. There was no increase in the hardness number in copper or iron when using the Rockwell machine after 40 to 50 per cent. reduction; but, of course, that machine, although very useful, was only suitable for works practice.

A paper was read in abstract by Mr. Francis W. Rowe describing "Some Experiments on the Effect of Casting Temperature and Heat Treatment on the Physical Properties of a High-tin Bronze."

Mr. Primrose referred to the practical value of the paper. He believed it would be found that a reduction of the casting temperature appeared to produce a larger amount of the eutectoid. The fact that on annealing and on quenching an increased hardness was obtained was certainly a remarkable result. One fact brought out which affected not only this particular group of metals, but other combinations, was that when casting at high temperatures it was almost impossible to get proper contact, and the secret of success was low-temperature casting. That was an important practical point.

Professor Turner said that the alloy dealt with was peculiarly susceptible to casting temperatures and heat treatment. He believed that the information contributed by Mr. Rowe on the subject would prove very valuable.

Mr. Rowe, in a brief reply, referred to the suggestion that a greater amount of the delta eutectoid separated out at lower casting temperatures. The truth of that suggestion could no doubt be confirmed, but it would require more time than he could give to the subject at the moment. It was fairly well known that all the bronzes cast at low temperatures showed a segregation of the delta eutectoid and greater hardness, and the wearing properties of bronzes cast at low temperatures were better than those cast at higher temperatures.

A paper was presented by Mr. T. H. Turner, of which he and Mr. W. E. Ballard are joint authors, on "Metal Spraying and Sprayed Metal." A number of samples of sprayed metal production were exhibited and created a good deal of interest.

METAL SPRAYING.

This paper brings under consideration the process of metallisation invented shortly before the war, and known generally as Schoop's metal spray process. Held back in its development by the unsettled condition of industry it is, nevertheless, being operated commercially at the present time in all the more important countries. The gas operated metal-spraying pistol now used in this country is illustrated, together with a rumbling barrel type of metallising apparatus, which is used for repetition work on small articles. Special devices have been introduced for coating the outside and inside of tubes and pipes. All articles to be sprayed are carefully sandblasted, as it has been shown in practice that the metallic coatings adhere better to surfaces so prepared. In certain cases pre-heating of the article to be coated is recommended, as this again tends to improve the adhesion. By spraying lightly on to glass slips, it has been possible to examine the individual particles of the sprayed metals. Photomicrographs of these show that the metal must be molten at the instant it strikes the surface to be coated. The remarkable shapes of the metal splashes shown will probably be of great interest to many. Solid articles have been built up by spraying and proved machineable and resonant.

Figures are given for the hardness and density of such built-up metals. Tables are included which show the wire and gas consumption. Practically any metal available in wire form and fusible in the oxy-hydrogen flame may be sprayed on to practically any surface, *e.g.*, on to paper, fabric, wood or metal. The surface produced is always matte, but may be polished if desired. The matte surface is an ideal foundation for paints. Considerable technical experience has now been obtained, and completed structures are being uniformly coated all over with any desired metal for protection against atmospheric corrosion, chemical attack or furnace conditions. The process has also been used for building up in repair and salvaging operations. It has found a particular field in ship work, and is recommended for the zincing of rail ends and fish-plates for connecting purposes on electric railways, as it does away with the necessity of copper connections and continual cleaning.

In the discussion Mr. G. B. Brook said that about a year ago he became interested in a process for the electro-deposition of metals on aluminium, using sprayed metal as an intermediate layer. It proved quite successful. With regard to the resistance of sprayed metals to corrosion, he had for some months had an iron plate sprayed with copper immersed in sea water at half tide. No test could be more drastic than that, and the plate had withstood it very well.

Dr. Vernon recalled the interest with which he witnessed a demonstration of the process shortly after its introduction. It was evident from the paper that lost time in the development of metal spraying was now being made up and that important applications were receiving serious consideration. Researches were now in progress to determine the exact character of the sprayed metal and the mechanism by which it was produced. The authors rightly laid stress on the employment of metal spraying as a protection against corrosion. The use of the process was restricted to metals of low melting point, and it was unfortunate that it could not be used for copper. Good results had been obtained with zinc. Sprayed zinc was said to be superior to galvanised material, and he would like some information as to tests on the sprayed metal as compared with the galvanised coating and of the sprayed metal with massive rolled zinc, and how it compared with pure zinc.

Mr. Marsden could not entirely agree that the zinc coating was a complete protection against corrosion. Now and again specimens stood up remarkably well, but on the whole the sprayed metal was rather patchy. The fact that it was impossible to be quite certain of protection against corrosion, especially with intricate parts, was, of course, a disadvantage, and the brittleness of the sprayed metal was another defect. Efforts should be directed towards an increase of the homogeneity of the material which, as tests had shown, could not be improved by hammering.

Mr. Turner, in a short reply to the discussion, said that many corrosion tests had been carried out. No comparison of sprayed zinc with massive rolled zinc had been made by the authors, but the need for such tests would not be overlooked. Possibly that point had received the attention of other workers. He would include in his written reply some figures for sprayed and galvanised material.

The next paper taken was one by Mr. D. M. Fairlie and Mr. G. B. Brook, and dealt with "The Determination of Sodium in Aluminium." It was followed by one by Mr. Francis W. Rome, which described "Some Experiments on the Influence of Casting Temperatures and Mass on the Physical Properties of Admiralty Gun-metal." The other papers on the agenda were taken as read.

Visits of inspection were paid to Woolwich Arsenal, the Mint, and a number of works in the London area presenting features of interest in the manufacture or use of non-ferrous metals.

A special visit to the National Physical Laboratory took place on the evening of September 11th. Members and other guests were received by Sir Joseph Petavel, and many demonstrations were given.

An Engineering Conference at Wembley.

THERE was held at the British Empire Exhibition, Wembley, on Monday, September 15th, a conference of Engineering Societies, organised by the Society of Engineers, at which a number of papers were read and discussed, dealing with various matters of engineering interest. Those attending included delegates from the Association of Engineering Shipbuilding Draughtsmen; the Battersea Polytechnic Engineering Society; the Birmingham Association of Mechanical Engineers; British Empire Producers' Organisation; the Ceylon Section, British Empire Exhibition; Institute of British Foundrymen; and the Women's Engineering Society. On the whole, the gathering could not be called a large one, but perhaps too much cannot be expected in a year which has been notable for so many conferences, both of an international and national character, as the result of the Exhibition.

The cost of organising such conferences is not inconsiderable, and it seems difficult to justify any action on the part of the Exhibition authorities which is likely to increase that cost unduly, especially when consideration is given to the objects of the Exhibition itself. It was stated at the Conference by Mr. A. S. Buckle, Senior Vice-president of the Society of Engineers, who presided, that efforts were made to hire a lantern in order to show some slides to illustrate one of the papers. The cost of hiring it was £5, but inasmuch as it was only required for about a quarter of an hour, the organisers of the Conference refused the offer and intimated that they would provide a lantern themselves. That, however, they were not allowed to do, and it was decided to dispense with the slides. On the morning of the Conference they were offered the lantern previously referred to for a fee of one guinea, but, unfortunately, the offer could not be accepted, because the slides were not then available. This kind of exploitation on the part of those connected with the Exhibition appears to be inexcusable, and the passive resistance offered by the organisers of the Conference is commendable.

The first paper presented at the Conference, by Miss C. Griff (chairman of the Women's Engineering Society and founder and managing director of the Stainless and Non-corrosive Metal Company, Birmingham), concerned the working of stainless steel. The authoress dealt with the commercial aspect of the working of this metal, and gave only personal experiences. Some success had attended the efforts which had been made to develop stainless alloys sufficiently soft to be machined, and the authoress appealed to users not to condemn stainless steel castings as being too hard to machine until they had given them a chance by grinding a small surface free of skin to give the tool a good starting-off place. That sounded a foolishly obvious piece of advice, but she had saved perfectly good stainless steel castings from the scrap heap by that practice. Another matter on which stress was laid was the need for specifying the brand of stainless steel required, or the carbon content, or stating the exact use to which the metal was to be put. The conclusion come to by the authoress was that stainless steel could be worked well as a commercial proposition, but of care and thought must be given to the quality and brand the steel for each particular job and the method of handling and the tools used; whilst overhead charges must be kept low to equalise the costs of material and labour. Roughly, the authoress's firm reckoned to allow 15 to 25 per cent. more for labour on stainless steel than for that on the working of mild steel.

Another paper, by Mr. A. R. Page, of the Birmingham Association of Mechanical Engineers, dealt with the problem of co-operation between the engineer and the works chemist. He found fault with both engineers and chemists for their conservatism, and urged the necessity for embracing every opportunity of co-operation. Summed up, his paper could be said to constitute a plea for team work, and instances were given in it and in the discussion which followed of the practical value of co-operation. An excellent example of the value of a laboratory was given by the author in the course of his reply to the discussion. The laboratory of his own firm cost about £10,000 a year. Last year one particular improvement had been discovered, which had saved the firm £10,000, so that it was able to get its money back as the result of that one improvement, which was one of many.

The uses and high qualities of Ceylon plumbago were discussed in a paper by Mr. T. G. Hunter. Ceylon is the only British possession which produces crystalline plumbago, and the paper, which was read at the request of the Commissioners of the Ceylon Pavilion at Wembley, served to emphasise the need for retaining that important industry within the Empire. After a description of the mining of plumbago in Ceylon, the author said that some of the uses for which plumbago was essential were the making of crucibles, lubricants, polishes, pencils, foundry facings and for electrical purposes. It might still be correct to say that the best crucibles could be made entirely with Ceylon plumbago, though they were now being made with a material containing proportions of other qualities. It might seriously be questioned whether any good crucibles were being made entirely without Ceylon plumbago, and it was probable that the higher the percentage of the Ceylon product in the mixture the more efficient was the crucible produced. This was certainly found to be the case in the United States of America, where they had tried to introduce their flaked graphite into crucible making, but it was considered inadvisable to go beyond 10 per cent. of this material, as anything more seriously affected the efficiency of the crucible. Indeed, it had been stated in America that in order to maintain the standard of efficiency in the plumbago crucible, it would be necessary to use the Ceylon product, whatever tariff might be imposed on it. The author remarked that the Ceylon plumbago industry was very much depressed for various reasons, one being the serious competition from Madagascar. But Madagascar had reached the stage at which it would have to depend on freshly mined plumbago, and would probably be unable to underquote the Ceylon product to any great extent, as in the past. Dr. C. A. Hewavitarne, Commissioner for Ceylon at Wembley, said that plumbago was an Imperial asset which we might lose very shortly unless England helped Ceylon; it might be found that within the next three or four years the plumbago industry might disappear from the Empire. One speaker in the discussion said that Madagascar could underquote the Ceylon product because of the low value of the franc, and that if exchange were normal it would be found that the Madagascar price was 200 per cent. above that of Ceylon.

Some examples of "Technical Popular Fallacies" were then given by Mr. A. S. E. Ackermann, B.Sc., on the lines of those dealt with in his well-known book on the subject.

A few interesting figures as to the working of the "Never-Stop Railway" at Wembley were then given by Mr. W. Yorath Lewis, chairman and managing director of Never-Stop Transit, Limited. Mr. Lewis stated that the number of passengers carried on the railway at Wembley was over 700,000, without accident. Each of the eighty-five cars had run about 3500 miles, aggregating some 300,000 car miles, and the driving spirals had made about 4,000,000 revolutions. It was too early to judge as to wear and tear, but so far the signs were most encouraging. As to power consumption, the spiral shafting, roughly 1¼ miles long, required only about 40 kilowatts input at the switchboard to drive it light at 100 revolutions per minute, including all cable, motor, gear and reverser losses. The railway consumed less than 200 kilowatts when running the full complement of cars at a scheduled speed of 6 miles per hour on a route having the equivalent of eight stations per mile, and numerous curves of only 180ft. radius, and gradients as steep as 1 in 12. The minimum and maximum speeds at present were 1 and 8 miles per hour, but they could be doubled, or even trebled, with corresponding increase of capacity, which was now roughly 5000 seats, or 7500 places per hour in each direction. In proof of this, Mr. Lewis said that the Southend Never-Stop Railway last year carried a crowd at the rate of 12,000 passengers per hour without the slightest hitch at a scheduled speed of 8 miles per hour on a route having the equivalent of twelve stations per mile, the minimum and maximum speeds being 2 and 16 miles per hour, the input of power being correspondingly favourable. These capacities, speeds, stops per miles, and power consumptions were superior to the best possible with electric trains or tramcars, or with petrol omnibuses, and he was confident that operating, labour, stores, maintenance, repairs and renewals and capital charges would also be found advantageous in comparison with those of any of the existing systems. He did not put forward the never-stop system as a substitute for electric traction in its proper sphere, which sphere was the relatively long-distance, high-speed, dense traffic along suburban routes, with stations certainly not less than half a mile apart. The dense short haul traffic, demanding four, five or six stations per mile, great carrying capacity and double the present effective speed, could only be met by the never-stop system.

THE Victoria Quay at Fremantle, W.A., is be to reconstructed with reinforced concrete piles for a length of 5055ft. This decision is the result of exhaustive experiments. Originally the entire structure was built of jarrah, but considerable havoc was wrought by the teredo and other seaworms. A pile-making plant has been erected in the vicinity of the wharf and already 250 piles have been completed.

Machine Tool and Engineering Exhibition at Olympia.

No. III.*

JAMES ARCHDALE AND CO., LIMITED.

Drilling Machines.—Among a number of interesting drilling machines exhibited by James Archdale and Co., Limited, of Birmingham, the heavy duty three-spindle gang drilling machine shown in Fig. 34 stands out conspicuously. This type of machine is made with from one to four spindles. In the design the makers have sought to secure great robustness at all points, and by reducing the number of working parts to the lowest possible, to ensure against breakdown under heavy duties. The power absorbed is 6¼ horse-power per head, and holes up to 3in. in diameter and 10in. deep may be drilled in mild steel. Each head is driven separately from a constant-speed belt pulley shaft, from which the power is transmitted to the spindle through spiral bevel gearing. No great range of spindle speeds is provided, as a regular part of the machine. In fact, only one pair of gear wheels giving two spindle speeds is provided as a standard part of the equipment. These wheels are selected by the customer to suit his particular needs. Other sets are supplied as extras. The wheels are secured to their shafts by keys, for which an extractor is supplied to facilitate the work of changing the wheels. The spindle is formed with six keys machined from the solid and is balanced by a counterweight. Four feeds ranging from 32 to 130 revolutions per inch are arranged for, the change being controlled by a lever placed within the operator's convenient reach, the feeds being engaged or disengaged by means of a friction clutch. A graduated disc on the side of the head enables a positively operated automatic depth drilling device to be brought into operation at any predetermined point. The work table is mounted on slides on the fronts of the columns and is raised and lowered through the agency of telescopic screws operated from a central hand wheel. A total vertical adjustment of 21in. can thus be obtained. The spindles are spaced 26½in. apart and the table has an area of 15in. by 46in.

The above-described machine is particularly adapted for carrying multi-spindle heads, of which an example exhibited by Messrs. Archdale is illustrated in Fig. 38. The six-spindle head shown is designed to drill six ⅞in. holes in steel at the rate of 1in. per minute. Each spindle is carried in a phosphor-bronze housing supported rigidly on a stud. The housings may be adjusted round the stud axes, and the studs, with the exception of two, which are diametrically opposite, can be adjusted in a circular slot concentric with the main spindle axis. The studs carry gear wheels which mesh with the main driving gear wheel and the wheels on the drill spindles. The spindles may be set anywhere within an area included between two circles of 6½in. and 16½in. diameter. Any pair of adjacent spindles may be set a minimum distance apart of $2^{11}/_{16}$in. centre to centre.

A sensitive radial drilling and tapping machine which the firm is exhibiting and which, we are informed, is entirely new in design is illustrated in Fig. 35. This machine is particularly intended for drilling parts such as petrol engine cylinder blocks and crank cases, in which small holes have to be drilled over a large area. The radial arm swings on ball and roller bearings and is supported at its outer end by a stay from the bed-plate. The foot of this stay is carried on a segment extending to the rear of the work table in such a way as to render the stay effective with the spindle over any point of the greater proportion of the base. Wipers are arranged to keep the surface of the segment clean. Adjustment of the arm, even with the saddle in the extreme out position, is made easy by the provision of roller and ball bearings at the end of the stay. No lock is provided for the stay, a clamp being brought automatically into action by the end thrust generated as soon as drilling is begun. The saddle, in addition to carrying its own locking device, is also equipped with a lever for locking the arm to the pillar, so that the adjustment and locking of the arm and saddle may both be made from the operating position. A dial plate is provided on the saddle front, whereby drilling may be stopped at any required depth. The saddle is equipped with a drilling and a tapping spindle, the latter running at one-

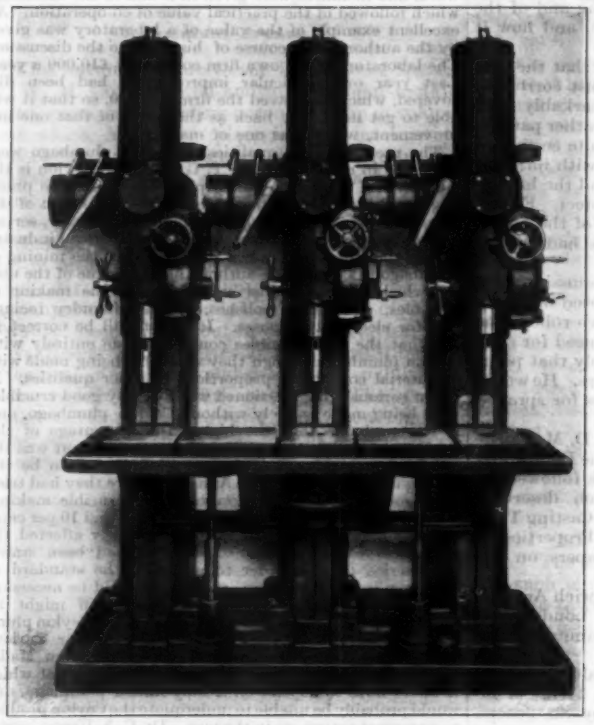


FIG. 34—GANG DRILLING MACHINE—ARCHDALE

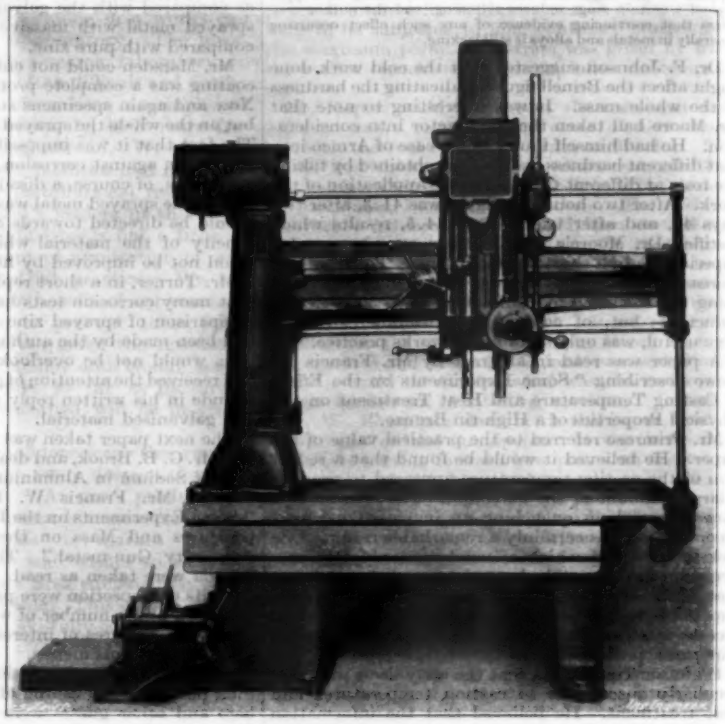


FIG. 35—SENSITIVE RADIAL DRILLING MACHINE—ARCHDALE

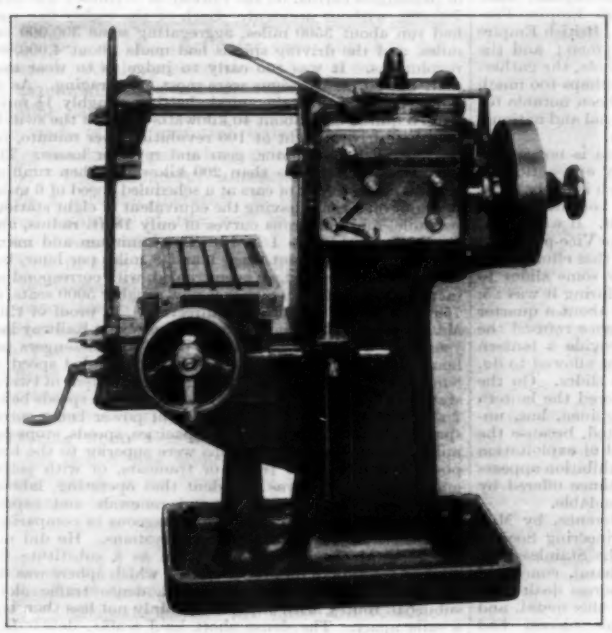


FIG. 36—ALL-GEARED MILLING MACHINE—ARCHDALE

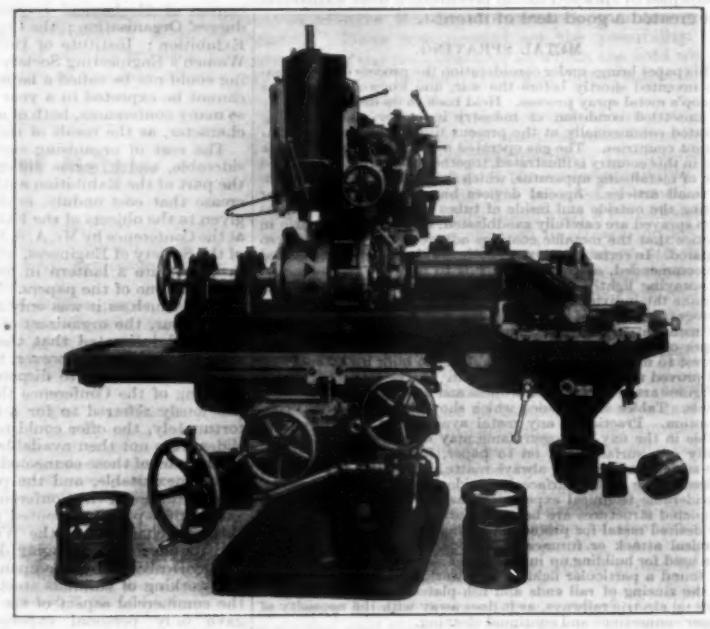


FIG. 37—PORT MILLING ATTACHMENT—ARCHDALE

* No. II. appeared Sept. 12th.

fourth the drilling spindle speed and reversing at one and a-half times the tapping speed. A hand wheel is provided which, when given one turn, centres the tapping spindle over the hole drilled by the other spindle. A slipping device for tapping, adjustable to suit different sizes of tap, is embodied in the design of the saddle. Three gear-driven feeds are provided and nine changes of spindle speed can be obtained through a sliding wheel gear-box at the top of the column. A hand lever feed motion is fitted for sensitive drilling.

Milling Machines.—Among the milling machines exhibited by Messrs. Archdale is the 18in. all-geared horizontal machine illustrated in Fig. 36. This machine has been designed with a view to securing

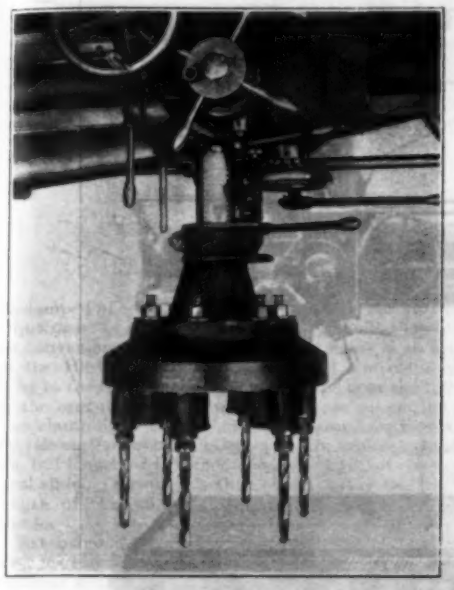


FIG. 38—MULTI-SPINDLE DRILLING HEAD—ARCHDALE

rigidity, simplicity and rapidity of handling combined with efficiency and accuracy in the work. In appearance it is certainly noteworthily "clean." It is driven from a constant-speed belt pulley through a sliding wheel gear-box giving six changes of speed to the spindle ranging from 36 to 455 revolutions per minute. All the gearing in the change-speed box is of hardened steel and is automatically lubricated by means of an oil pump drawing its supply from a tank formed in the body of the machine. The drive is started and stopped through a clutch operated from a lever projecting at the front of the column. The spindle is hollow and is provided with a draw bolt for the arbor. A steel steady arm braced to the knee bracket serves to support the outer end of the arbor. A self-acting feed motion gives four rates of feed varying from 1.52in. to 6.13in. per minute. Automatic feed engagement and knock-off arrangements are provided and the slides are fitted with indexed discs for indicating their movements. The middle slide is of a new design. It is of increased length and is equipped with two separately adjustable taper strips. The makers claim that the improvements effected in this slide permit the machine to take increased weights of work without loss of alignment besides ensuring freedom from vibration. The knee has also been strengthened and is provided with a sliding cover which protects the transverse screw from fouling by the swarf and cutting lubricant. Under test conditions, the makers inform us, the machine has taken a cut 3in. wide and 0.269in. deep at the rate of 6.13in. per minute in mild steel.

The firm is also showing one of its 30in. vertical milling machines fitted with an attachment for milling the ports in locomotive piston valve liners. Beyond the fact that a vertical automatic feed arrangement is fitted to the knee the attachment is a separate unit, which can be removed so as to free the machine, if required, for ordinary milling work. The attachment as shown in Fig. 37 is mounted on the ordinary table of the machine, and the liner to be milled is carried on it in a revolving work holder which can be indexed into a series of angular positions by means of a locking bolt. After the initial hole has been milled in the liner the shape of the port is entirely controlled by a cam and roller governing the feed. The cams are of a simple form and can be arranged to give any desired shape of port. It is thus possible to dispense entirely with the operation of marking out the liner, the positions and shapes of the ports being governed by the machine itself. In the case of the liner illustrated in the engraving the fourteen triangular ports, each measuring 2¼in. along its base, were, we are informed, completely milled from the solid in a floor-to-floor time of 2½ hours. In another example six rectangular ports 1¼in. wide and presenting a total area of about 36 square inches were similarly milled in 45 minutes.

GEORGE H. ALEXANDER MACHINERY, LIMITED.

Bolt Heading Machine.—The stand of George H. Alexander Machinery, Limited, is principally devoted to American made machinery, amongst which is shown in operation a complete equipment for making bolts and screws from wire rods. The machines were all made by the Waterbury Farrel Foundry and Machine Company, and comprise a solid die double-stroke header, an open die double-stroke crank header, an automatic bolt-head trimming machine, two screw thread rolling machines, and a screw head slotter. Of these machines the open die header is perhaps the most interesting, and we give two views of it in Figs. 39 and 40. It is shown at work knocking up heads ¾in. in diameter by a full ¼in. thick on wire rod $^{5}/_{16}$in. in diameter and running at the rate of ninety pieces a minute. It is, of course, impossible to produce such a large head with a single blow of the dies, and as a consequence the machine has to make two strokes for each piece. At the first stroke the end of the blank is squeezed out into a pear shape and the second blow produces a finished round head. A second operation in the head trimming machine produces the orthodox hexagon bolt head.

As is the case with all other Waterbury heading machines, the thrust of the dies is quite positive—there is no spring action—and as a consequence all the heads must be true to size. The thrust is produced by a crank, which might be better described as an excentric, as it has no webs, and this arrangement enables the bearings of the shaft itself and of the connecting-rod to be brought close together. There is consequently practically no bending action on the shaft and the positive blow just referred to is obtained. In order, however, to guard against the wreckage of the machine in the event of any obstruction coming between the dies, the two fly-wheels are connected to the crank shaft through friction clutches, which slip in the case of an accident.

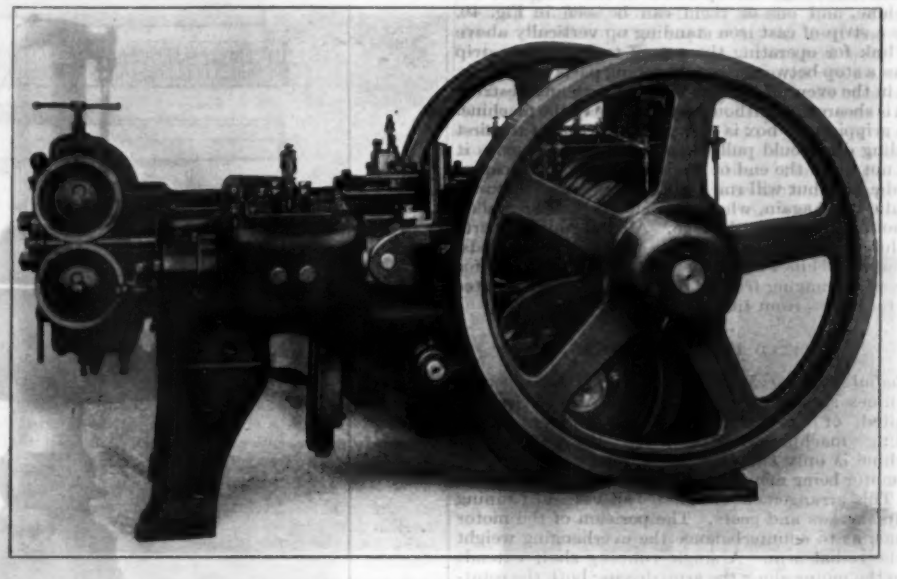


FIG. 40—OPEN-DIE HEADER FOR BOLTS AND SCREWS—ALEXANDER

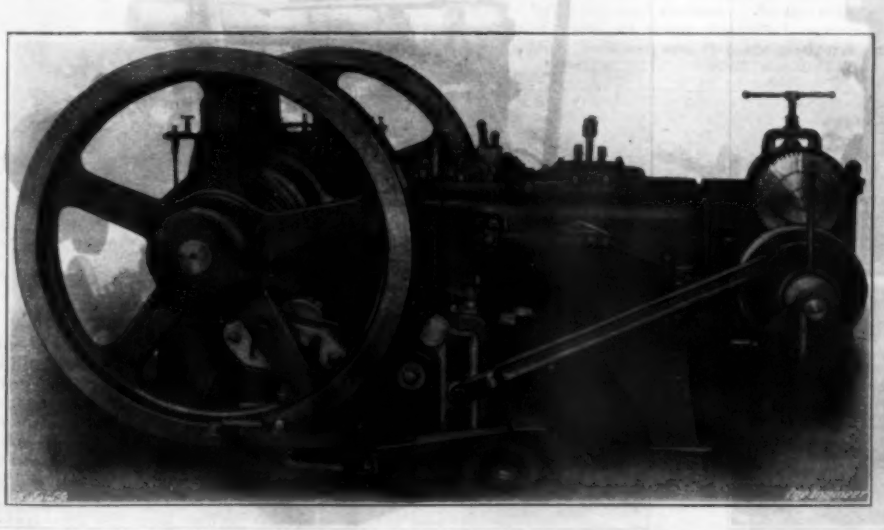


FIG. 39—OPEN-DIE HEADER FOR BOLTS AND SCREWS—ALEXANDER

As it is necessary to make two blows for each piece produced, the die box has to have two movements, one for the actual blow and the other to bring the proper die into the working position. The blow is, of course, produced by the horizontal movement of the slide by the crank. The other movement is a vertical displacement of the die box by the cam, which can be seen behind the fly-wheel in Fig. 39. This cam works a slotted rocking lever, which, in turn, operates a horizontally projecting lever beneath the frame of the machine. The outer end of this lever has a crosshead working in slides in the die box to accommodate the horizontal movement, and the cam is so shaped that the die box is held stationary during the working stroke. In order to provide for the adjustment of the dies in a vertical direction the connection between the rocking lever and its shaft is effected through two opposed springs and correspondingly opposed screws, so that the attendant need only adjust the screws and the springs will ensure that there is no backlash.

The slotted rocking lever also actuates the feed of the stock to the machine through a long connecting-rod. By moving the end of this rod in the slot the rate of feed is naturally varied. The opposite end of the rod gives an oscillating motion to one member of a free-wheel type of clutch, which drives the feed rolls seen on the left in Fig. 40. There is a brake block bearing against the outer member of the clutch with just sufficient pressure to ensure that it does not feed back on the return stroke of the connecting-rod. The lever standing up in front of the feed gear—see Fig. 39—is for stopping and starting the feed, and it is interconnected with the dies by the levers running along the side of the frame in such a way that the feed can only be started when the dies are in the proper position.

The operation of the machine is as follows:—The feed rolls feed the rod forward between the two halves of a gripping die, which is open at this time, until it meets a stop that determines the length of the blank; the dies are then closed together to grip the rod with sufficient material protruding for making the head. A powerful toggle in the box, seen on the side of the machine in Fig. 40, then moves the gripping die bodily sideways, and in doing so shears off the blank. In the new position the blank abuts against the back of the die box, which takes the thrust of the first blow by the heading die, when the pear-shaped head is produced. The heading dies then make their return stroke, the finishing die is brought into position and another blow is struck. Finally the

gripping dies return to their original position, open, and the next feed motion pushes out the finished piece. Just as it emerges from the dies the stop already mentioned is given a sharp sideways movement which knocks the piece clear and ensures that it does not foul the next stroke of the dies. This last movement may seem only a small matter, but it is very essential, as the machine runs at such a speed that gravity alone will not clear the pieces away fast enough.

Besides the safety devices already mentioned, several others are incorporated in the design of the machine, and one of them can be seen in Fig. 40. It is a strip of cast iron standing up vertically above the link for operating the cut-off toggle. This strip forms a stop between two telescoping parts of the link, and in the event of the dies meeting with any obstruction is sheared off without any damage to the machine. The gripping die box is also so shaped that if the first heading die should pull the blank out of the grips it will not drive the end of the blank against the cap of the die box, but will run clear until it comes opposite the die itself again, when the machine will be stalled without causing any damage. All the running parts are lubricated by an extensive system of drip feeds.

These machines are made in five different sizes for wire stock ranging from $^{3}/_{16}$in. up to $\frac{5}{8}$in. in diameter and for blanks from 4in. to 8$\frac{1}{2}$in. long.

ALFRED HERBERT, LIMITED.

Radial Drilling Machine.—Among the numerous machines shown on the stands of Alfred Herbert, Limited, of Coventry, is the motor-driven radial drilling machine illustrated in Fig. 41. The machine is only supplied in the motor-driven form, the motor being mounted on the arm and moving with it. This arrangement eliminates all vertical running shafts, screws and gears. The position of the motor is such as to counterbalance the overhanging weight of the radial arm. A single running shaft extends from the motor along the arm, driving both the rotating nut of the fixed elevating screw and the main spindle of the machine. This is the only running shaft on the machine, except those contained in the saddle.

The column consists of a central pillar bolted to the base plate and surrounded by a long sleeve which rotates freely upon it, the weight being taken by a ball bearing at the top and the side thrust by roller bearings. The radial arm is of circular pipe section. The raising and lowering of the radial arm are effected—as already indicated—by a stationary screw and rotating nut. The nut is driven in either direction by a worm wheel and worm from the main motor through the medium of a clutch, which is engaged by the action of unclamping the arm. The operations of unclamping, engaging and disengaging the clutch and re-clamping are all performed by means of one lever carried on the saddle. It is impossible for the clutch to be engaged while the arm is clamped. A safety device protects the mechanism from damage should the arm reach the top or bottom of its traverse.

The saddle carries all the speed and feed-changing gears, and is driven directly by the shaft mentioned above, which is simply a prolongation of the motor spindle. There are thus no driving gears anywhere except on the saddle, a fact which is claimed to make the drive silent, efficient and free from danger. The saddle is mounted on rollers, which take all the weight and the outward thrust produced by the weight, and is thus, it is claimed, rendered very sensitive in its movement along the arm. The saddle is clamped to the arm and the sleeve to the column simultaneously by a single hand lever on the right-hand side of the saddle. The saddle is clamped at a point directly behind the spindle by a wedge plunger and screw coupled to the hand lever by a connecting-rod. The sleeve is clamped to the column by a bolt and eccentric mounted on the sleeve at the lower end of a vertical shaft, which shaft is connected to the hand lever on the saddle through bevel gearing and a horizontal shaft. The fulcrum of the hand lever is made to "float" in order to equalise the effort applied to both clamps.

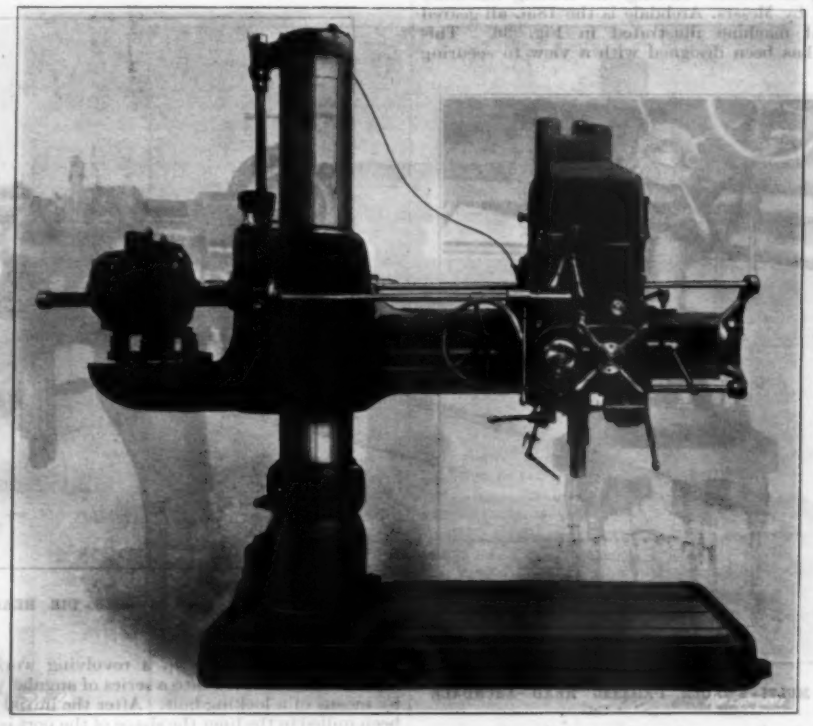
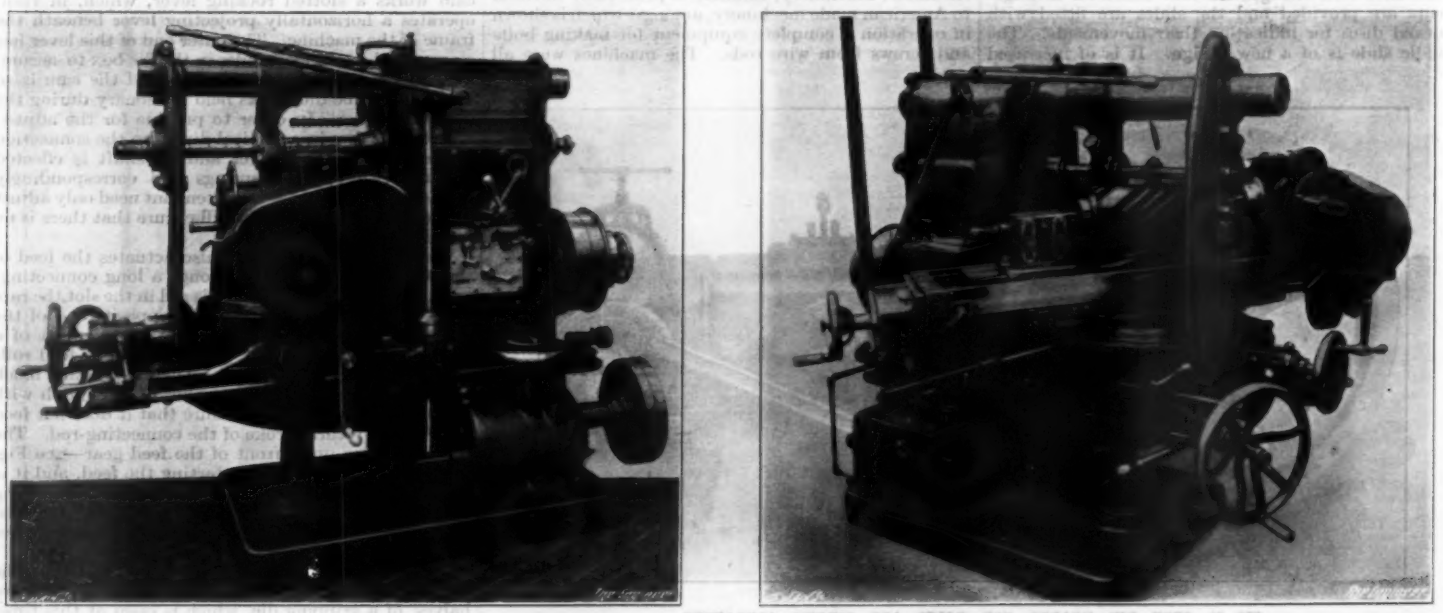


FIG. 41—MOTOR-DRIVEN RADIAL DRILLING MACHINE—ALFRED HERBERT

The spindle has sixteen changes of speed, all obtained by gearing, which is totally enclosed in the saddle. Eight changes are made by means of sliding gears, and these changes are doubled by back gearing operated by friction clutches. The speed changes are operated by levers which are carried on the front of the saddle casing. The motor is started, stopped and reversed by a lever on the saddle. There are six feeds, the changes being made by rotating a dial on the front of the saddle. An automatic feed stop is provided, consisting of an adjustable lever on the front of the saddle. It can be instantly set and covers the whole range of the spindle traverse. The spindle may be set at a maximum radius of 6ft. 6in. at a maximum height of 6ft. above the base plate and at a minimum height of 12in. The motor is of 8 horse-power.

Universal Milling Machine.—The Herbert No. 16 universal milling machine, illustrated in Figs. 42 and 43, is claimed to possess many original features which differentiate it from others of its class. Commencing with the table drive, which is perhaps the most vital of the various mechanisms in any universal milling machine, the new and original feature claimed by Messrs. Herbert is the fact that the screw, instead of being driven by a small pair of bevel gears which run at the same speed as the screw, is driven by gears running at more than three times the speed, the load thus being reduced in proportion for any given cut and the capacity of the gears to transmit feed power being increased in the same proportion when heavy cutting has to be done. In Fig. 44 we reproduce a drawing showing the patented table drive and clutch. The screw is 1$\frac{1}{4}$in. diameter, and is driven by an internal gear wheel having sixty teeth. The pinion has eighteen teeth, and is solid on a shaft driven by steel bevel gearing. It is believed by Messrs. Herbert that there is no other universal milling machine with such a drive. The feed clutch is an essential part of the drive, and is claimed to be quite novel in design. The teeth are made at a self-releasing angle of 45 deg., so that their tendency is to disengage, no matter how much power is being transmitted. They are held from disengagement, however, by two catches or triggers carried by one clutch and hooking over a flange on the other. These triggers rotate with the clutches when they are engaged, without relative motion and without wear, and are disengaged by hand or automatically by a contrivance



FIGS. 42 AND 43—UNIVERSAL MILLING MACHINE—ALFRED HERBERT

which requires very little force to operate it. This type of clutch, it is claimed, will always disengage with ease, and when disengaged the screw is free and can be rotated easily by hand without rotating the shaft from which it is driven.

The knee of a universal milling machine has to be

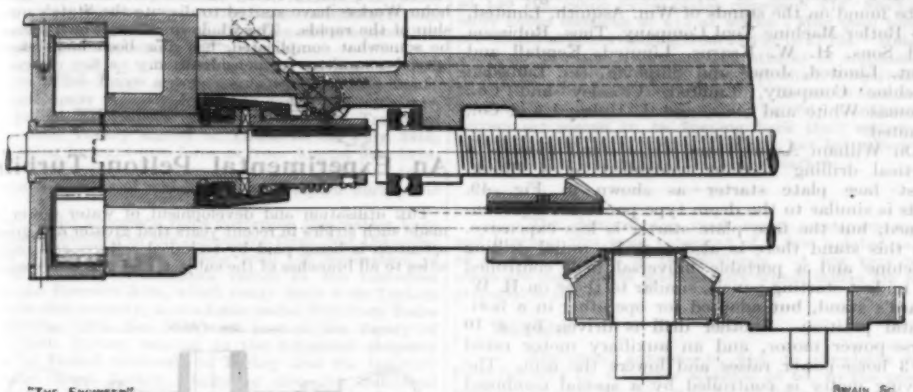


FIG. 44—TABLE DRIVE OF HERBERT UNIVERSAL MILLING MACHINE

unclamped and clamped again every time the vertical adjustment is used. The clamping should therefore be convenient and efficient. Convenience is secured in the Herbert machine by bringing the clamping lever to the front of the knee so as to be near the hand of the operator when winding the knee up or down. The clamping is effected, as represented in Fig. 45, by the end movement of a taper gib, which extends the full length of the knee where it bears on the vertical slide. Clamping is thus effected over the whole length of this surface, and not merely at certain points.

Extensive experiments with "all-geared" drives were held by Messrs. Herbert to show that the tumbler motions so popular when these drives first came into use were unsound in principle, and unsatisfactory in practice for anything but light duty. On a heavy-duty machine, such as is now being dealt with, all the gear wheels are hardened, and all speed changes

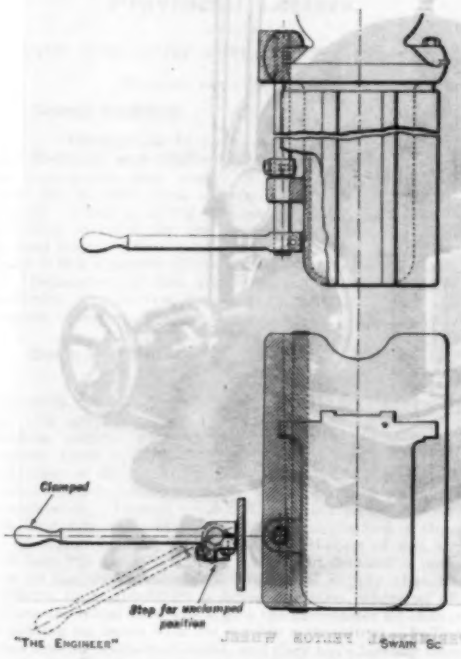


FIG. 45—KNEE CLAMPING DETAILS

are made by sliding the wheels along their shafts. No sliding gears are, however, employed on the main spindle, to which all the gears are rigidly keyed, the intention being to avoid chatter and vibration. For heavy cuts the power is transmitted through a large gear keyed solidly to the spindle just behind the front bearing.

For heavy cutting the use of an arm brace is essential, but the ordinary type of arm brace as usually furnished with universal milling machines cannot be used when milling spirals with the table at other than a small angle. In the Herbert machine the offset reversible arm brace—as shown in Fig. 43—is adaptable for use with the table swung to as much as 35 deg. on either side and greatly increases, it is claimed, the productiveness of the machine on spiral work.

In connection with the universal dividing head three methods of indexing are available, viz.:—(*a*) Direct indexing by disconnecting the spindle from the worm gear. With this form of indexing the divisions obtained with the standard index plate are 2, 3, 4, 6, 8, 12 and 24. (*b*) Plain worm indexing, giving all numbers up to 60, all even numbers and all numbers divisible by 5 up to 120, and many other numbers up to 2640, and (*c*) differential indexing covering all numbers up to 400, including all prime numbers. For spiral milling the standard change gears enable spirals varying from .694in. up to 144in. pitch to be milled. A universal dividing head to be accurate must have a large worm gear and an accurately fitting worm. These ends are achieved in the Herbert machine by mounting the worm above the worm gear—as shown in Fig. 46—and maintaining the worm and gear permanently in engagement even when direct indexing is being done. The worm gear is of phosphor bronze and runs in oil, and the worm is hardened and ground. As the adjustment, when once made, is never disturbed, accuracy and freedom from backlash are, it is claimed, maintained over long periods. Adjustment can, however, be made if eventually required. The device for connecting and disconnecting the worm gear and spindle can be operated at any point without waiting for a tooth to come round, and thus provides for very fine angular adjustments of the spindle. The driving dog, although screwed on the threaded spindle nose, has a positive attachment, so that it cannot slip in use, no matter which hand of spiral is being milled. The index plates are of large diameter, 8¾in. The holes are drilled clear through, so as not to become clogged up by dirt. The plates are clamped without backlash, and when used in the fixed position are attached positively so that no movement can take place. The index sector is graduated to avoid having to count the holes when setting up.

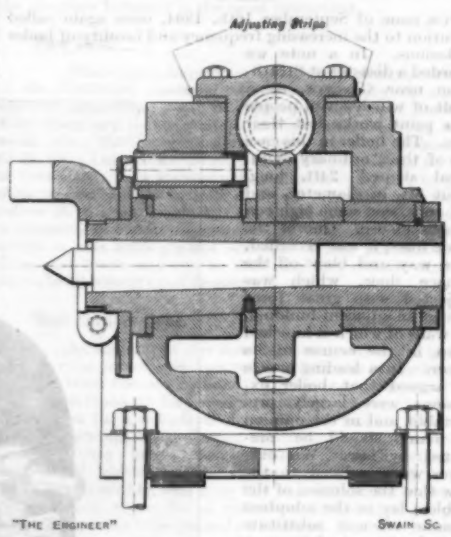


FIG. 46—DIVIDING HEAD

FIG. 47—VERTICAL MILLING ATTACHMENT

There has been much controversy in the past as to the correct way to drive the feed motion of a milling machine, but nothing, Messrs. Herbert argue, has emerged superior to driving the feed from the constant speed driving pulley by a good wide belt, giving ample power and having enough resilience and ability to slip to avoid breakages in case of a jamb. On some machines breaking pieces form part of the transmission, but they are held to be not only a nuisance, but unreliable, as they do not act in the same way at different velocities. The transmission from the feed box to the knee and table in the machine illustrated is by shafts and gearing, without universal joints. The patented dial feed box provides eighteen feeds, the changes being made by simply rotating a hand wheel until the required number on the dial comes opposite a pointer. There are thus no tables to consult and no co-ordinated movements to be effected.

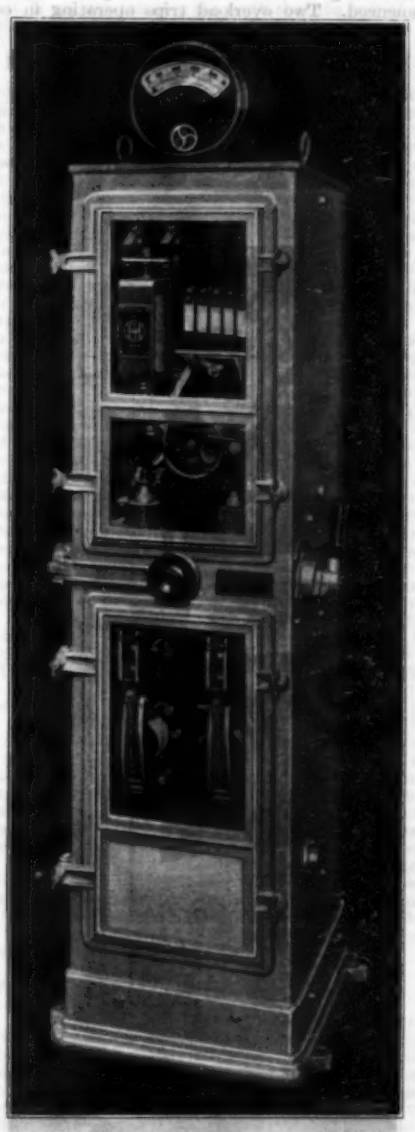


FIG. 48—SWITCHGEAR FOR PLANER—BROOKHIRST

It is a difficult problem to make all the lubrication of a complicated machine entirely automatic, and probably not worth its high cost, but it is essential that all elements taking part in heavy duty should have adequate lubrication. Automatic oiling has therefore been provided for the driving box, the feed box, the feed transmission gears and the table and knee slides. The places where an oil can has to be used are thus few, and of minor importance.

The vertical attachment—Fig. 47—is suitable for very varied work. It has the same standard spindle nose and taper hole as the main spindle. The nose is much higher up than usual, so as to allow work up to 16in. in height to be admitted between it and the table. It will swing to any angle, and will take any cut that the machine will drive.

BROOKHIRST SWITCHGEAR.

Electrical control gear now plays a very important part in the operation of machine tools, and a good

collection of this gear is to be seen at Olympia. Although Brookhirst Switchgear, Limited, of Chester, are exhibiting at the British Empire Exhibition, the firm has also a small stand at the Machine Tool Exhibition. The firm's starters can, however, best be seen on various stands of the Machine Tool Manufacturers, where they are used for controlling motors, driving various kinds of tools. On W. H. Ward and Co.'s stand, for instance, two combination turret lathes, a hexigon turret lathe and a broaching machine are all controlled by Brookhirst switch panels. In each case the starters are of the drum type, and although no spring device is used, there is no possibility of the starter being left in an intermediate position. The main circuit is opened and closed by two electrically-operated magnetic blow-out contactors, and to close them the ratchet operating handle must be raised to an upright position before the starting operation is commenced. The handle may then be moved forward on the ratchet principle, but if the handle is released before the full on position is reached, the electrically-operated contactors are opened, and the contactors cannot be closed again unless the whole operation is recommenced. Two overload trips operating in con-

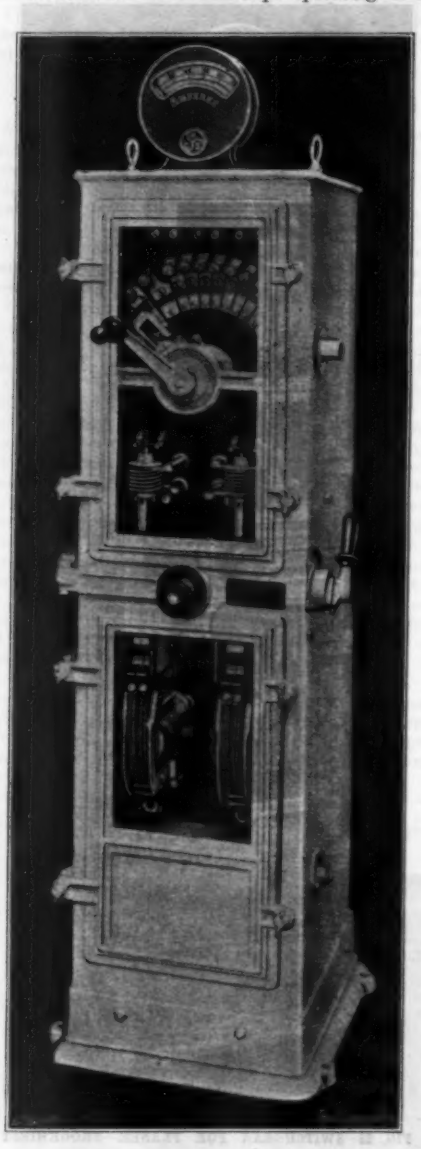


FIG. 48—SWITCHGEAR FOR DRILLING MACHINE

junction with the contactors, provide complete overload and no-volt protection, whilst an isolating switch in a sealed compartment fully safeguards the operator against shock. This switch is interlocked with the doors of the case, so that the doors cannot be opened unless the switch is in the off position and the switch gear is dead. On the same stand a smaller combination turret lathe and five capstans are controlled by Brookhirst midget type panels. The operation of these panels corresponds in many ways with those just described, but the panels are more suitable for the control of small motors. The starters are of the face plate type, and protection is provided by a no-volt release, an overload trip and two fuses. A quick break hand-operated main switch, in a separate sealed chamber, is introduced so that it must be in the off position before the door can be opened.

On the stand of Haggas and Smith there is a pulley turning lathe, controlled by a drum type starting panel, similar to that described, but the starter is provided with a separate push button for inching or stopping, thus enabling operations to be carried out at any convenient point on the lathe, as well as at the starting panel. A planing machine on this stand is controlled by a Brookhirst solenoid starting panel, as shown in Fig. 48. A three-point push button switch for starting, inching and stopping enables the machine to be controlled from the machine, and the starting panel can be placed at any convenient position in the shop.

Other examples of Brookhirst switchgear are to be found on the stands of Wm. Asquith, Limited, the Butler Machine Tool Company, Thos. Robinson and Sons, H. W. Kearns, Limited, Kendall and Gent, Limited, Jones and Shipman, the Lumsden Machine Company, Limited, Crossley and Co., Thomas White and Sons, and J. Holroyd and Co., Limited.

On William Asquith and Co.'s stand there is a vertical drilling machine controlled by a Brookhirst face plate starter—as shown in Fig. 49. This is similar to the drum type panel already mentioned, but the face plate starter is less expensive. On this stand there is also a girder radial drilling machine and a portable universal drill controlled by midget starting panels, similar to those on H. W. Ward's stand, but adapted for operating in a horizontal position. Another drill is driven by a 10 horse-power motor, and an auxiliary motor rated at 3 horse-power raises and lowers the arm. The driving motor is controlled by a special combined starting and speed-regulating switch of the face plate type, operated through bevel gearing by a hand wheel placed in a convenient position. The auxiliary motor is contolled by a small "straight on" starter and reverser.

SIXTY YEARS AGO.

OUR issue of September 16th, 1864, once again called attention to the increasing frequency and fatality of boiler explosions. In a note we recorded a disaster at Strathblane near Glasgow, as a result of which seven people at a print works lost their lives. The boiler in this case was of the "ordinary cylindrical shape," 24ft. long, about 8ft. in diameter, and had only been some eighteen months in use. One of the inside flues, it was recorded, gave way and blew off the furnace door, which was projected with great force against an adjacent building, the walls of which it knocked down in the course of its career. In a leading article we argued that boiler explosions were largely preventable, and in the opinion of many should be prevented by law. We ourselves were inclined to the view that the solution of the problem lay in the adoption of some efficient substitute for "the large and to some extent, necessarily, dangerous forms of boiler in common use." Such an alternative, we suggested, might be found in the water-tube boiler. Although this form of boiler had been studied and tried from the early days of the century, the success achieved with it had never been complete. In some cases failure was caused by the choking of the tubes with scale. In others the water was sometimes driven away from the heating surfaces with the result that these surfaces were burnt. The adoption of cast iron, we suggested, would get over the trouble caused by scaling in the "boiling vessels," and, moreover, would eliminate serious corrosion. Perfect circulation could be secured by using spherical boiling vessels having free communication with each other in several directions.

HYDRO-ELECTRIC SCHEMES IN FINLAND.

UNDER the hydro-electric scheme for Narva (Finland), which has been under consideration since 1919, it is proposed to construct a big water power plant for the complete electrification of the surrounding country, supplying light and power to industries, railways, towns and agricultural districts. To begin with, the local industries would be electrified, and, among other new undertakings, big nitre works are to be established. The total water power is estimated at from 65,000 to 90,000 horse-power, out of which quantity it is expected that from 62,000 to 21,600 horse-power could be made available for use.

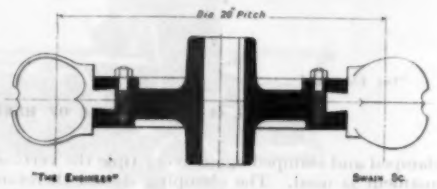
As regard the economic aspects of the problem, there is no difference of opinion, the only objections so far expressed referring to the risk of establishing the central power plant close to the Russian frontier.

The sums required for putting the scheme into effect is stated to be about 1,500,000,000 estmarks. It is understood that the Government has entered into negotiations with a British financial group in order to obtain a loan, amounting to £1,500,000, which would be paid off in the course of sixty years by annual payments of 7 per cent., including interest. The group interested, which includes Mr. Dickinson, of London, is represented in Reval by the firm of A. Menell and G. Lukk.

The whole question has quite recently, however, entered on quite a new phase, since two industrial firms at Narva—the Narva Linen Manufacture and the Kreenholm Works—have started to dispute the State's ownership of the rapids. The whole question, which seems to be somewhat complicated, has now been laid before a special committee for consideration.

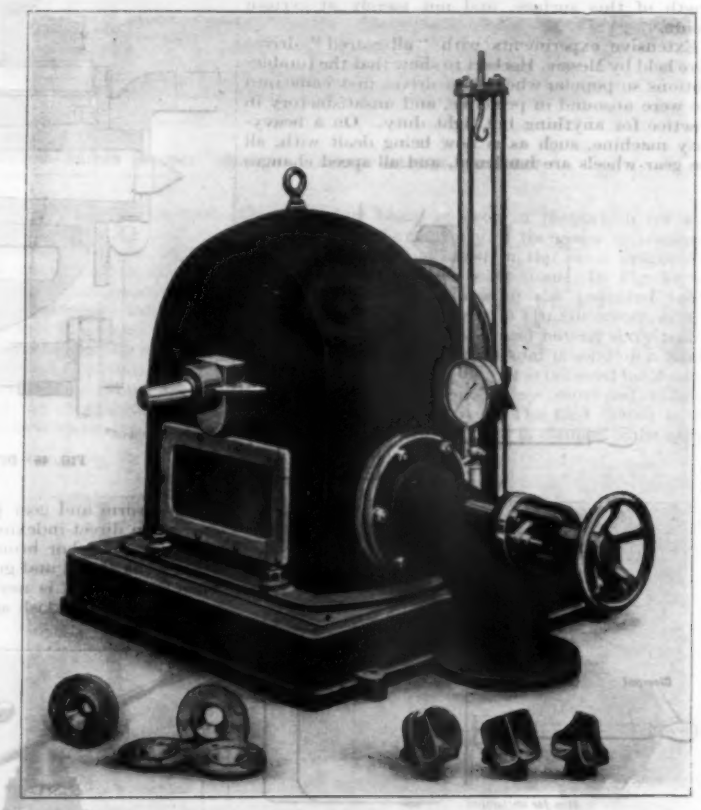
An Experimental Pelton Turbine.

THE utilisation and development of water power has made such strides in recent years that greater and greater attention is being paid by technical colleges and universities to all branches of the subject, and it is now common



RUNNER WITH REMOVABLE BUCKETS

to find in the laboratories of such institutions elaborate equipment for the teaching of applied hydraulics. An example of such equipment is provided by the experimental Pelton turbine which we illustrate on this page,



EXPERIMENTAL PELTON WHEEL

and which has been designed and made by Mr. Percy Pitman, of 25, Victoria-street, S.W., for the College of Engineering, Bangalore, India. This turbine has a Pelton wheel with a pitch diameter of 20in., and will develop about 10 brake horse-power, with a working head of 250ft. It has been designed to allow modifications to be readily made, and is provided with a set of interchangeable buckets and nozzle openings. The buckets have machined dove-tailed feet by which they are secured in a groove turned in the wheel, by the use of a loose ring. The casing is provided with two large plate-glass windows, through which the action of the jet can be studied. By removing one of these windows access to the interior is gained, and any changes can be made. The jet is controlled by a steel needle, working in bronze guides. Four extra nozzles of different diameters, but all turned to true hydraulic curves, are included in the equipment. A water-cooled brake drum is keyed to the shaft, and two uprights are provided for supporting the brake gear. A frictionless centrifugal water guard at each end prevents water from creeping along the shaft. The whole equipment is mounted on a cast iron bed-plate, which has a central opening for the escape of water.

Turkish Patents.

DURING the early stages of the war, as far as Turkey was concerned, many British inventors had to discontinue prosecution of their Turkish patent applications, as was the case with other countries involved in the war. With most of the remaining countries, for example, Germany and Austria, matters were settled some considerable time ago under the respective Peace Treaties and the procedure as regards patents became again normal.

This was not so with Turkey owing to the very late date on which Peace arrangements were actually made. Not until quite recently could one again deal with war-time patents in respect of Turkey, but the Treaty of Peace with Turkey signed at Lausanne on July 24th, 1923, being brought into force as from August 6th, 1924, patent relationships are again possible in respect of those patents the rights of which as it were lapsed during the war.

Few of the necessary rules governing the matter have yet been published in the customary form, but the order of the Board of Trade dealing with the restoration of patents of Turkish nationals vested in the custodian under the Enemies Acts, which really deals with Turkish rights in this country, is available under Statutory Rules and Orders, 1923, No. 1386, and part of the Treaty of Peace with Turkey relating to the industrial property rights of British nationals in Turkey and the territory separated from Turkey, including also the industrial property rights of Turkish nationals in Great Britain, is contained in the *Official Illustrated Journal of Patents* for August 13th, 1924.

Subject to the stipulations of the Treaty, rights of industrial, literary and artistic property as they existed on August 1st, 1914, in accordance with the law of each of the contracting countries, according to Article 86, as set out in the above official journal, shall be re-established or restored as from the coming into force of the present Treaty in the territories of the contracting parties in favour of the persons entitled to the benefit of them at the moment when the state of war commenced or of their legal representatives. Equal rights which but for the war could have been acquired during the war by means of an application legally made for the protection of industrial property, are to be recognised and established in favour of those persons who would have been entitled thereto from the coming into force of the Treaty.

One important part of the Treaty determines that the inhabitants of territories detached from Turkey are to continue in complete enjoyment in Turkey of all rights in industrial property to which they were entitled under Ottoman Law.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

General Conditions.

CONDITIONS in the iron and steel industry in the Midlands and Staffordshire have varied hardly at all during the past week. Nothing has happened to alter the attitude then adopted by producers and consumers. There is no big business on the horizon, and the inquiries to hand are not suggestive of any immediate general improvement in the tone of trade. The autumn trade is still a matter of conjecture, but it is not despaired of. Consumers of iron and steel desire to see tangible evidence of a revival before they will speculate. The market, therefore, remains dormant.

Crown Bar Prices.

Business in most departments of the finished iron trade has been very bad of late, and makers of Crown bar iron are now endeavouring to attract customers by shading prices. This week many of the Staffordshire makers have intimated their willingness to accept a reduction of 2s. 6d. per ton on the ruling figure of £13, while in other cases as much as 5s. per ton reduction is spoken of. Though some of the mills that were active not long ago are now closed down, the position of those in operation has not been bettered. Makers of nut and bolt bars are practically idle. A limited demand is being met so largely from foreign sources of supply that the industry in Staffordshire is being operated, where at all, on uneconomical lines which give the ironmaster no chance of getting on terms with his outside competitors. Selling rates rest on production costs, and they have already been so drastically cut that practically no profit remains. Makers say that £12 per ton is the minimum they can accept, consequently consumers, who in turn have to make a profit, are forced to accept Belgian material, though of inferior quality, at £8 2s. 6d. upwards. Marked bar houses have improved their order books a little lately, and continue to make £15 per ton the minimum as well as the standard figure. Most of the other operating Staffordshire mills, in the absence of iron orders, are engaged in re-rolling steel, mostly of foreign origin, and they are keenly competing with the large steel works, many of whom decline to accept the prices taken by the smaller mills.

Galvanised Sheets.

Galvanised sheets, though not so freely called for of late, still furnish the brightest corner of the market. Values, on the strength of previous heavy bookings, are fully maintained, £18 5s. being obtainable for galvanised corrugateds of 24-gauge. The loss of a large order for the Argentine is understood to be connected with English inability to give quick delivery. Thinner gauge sheets continue an excellent market.

Competition in Steel Department.

Business in steel continues on the basis of small orders, mainly for half products, and all to meet early requirements. Prices are still being heavily shaded under the pressure of keen competition. Re-rolled steel goes almost at consumers' price. Belgian sellers are, however, securing even more of this class of business than formerly. Angle and joist values are unchanged on the basis of the recent small reduction; £9 10s. to £10 are the figures generally quoted for tees, £10 10s. to £11 is asked. Ship, bridge and tank plates are in better request at £10 10s., while boiler plates command £14. Staffordshire hoops continue at £12 at works. Mild steel billets are offered at prices ranging from £7 10s. to £7 15s. Makers show no disposition to meet the attacks of continental sellers, who quote £5 13s. at Antwerp, which is equivalent to £6 10s. delivered in the Midlands. In one or two cases material has been offered at £6 7s. 6d. Continental buyers are stated to be keeping back their orders in anticipation of lower prices, and this has led sellers to cultivate more thoroughly the British market.

Steel Scrap.

The demand for steel scrap continues weak and business this week consisted of a few isolated sales at £3 15s. delivered in the Midlands. A few very low offers are being made speculatively which sellers are not prepared to accept.

Tin-plates.

The recent advance of 4½d. in tin-plates has been followed by a further addition of 6d. to the price, making the basis 23s. 6d., with 1s. off for wasters. At the same time the 3s. 6d. taken off sheet bars has been reinstated, so that the gross price returns to £8 12s. 6d., less the usual abatements. The reasons given for again increasing the selling rates for tin-plates are the upward movement of the tin market and the demands of labour. Mill owners have negotiated such substantial contracts that they are able to indemnify themselves against the enhanced cost of production. The fluctuations in the price of tin are a frequent source of anxiety in the industries which depend upon that metal, and of which the tin-plate industry is the most important.

Raw Iron.

There is no improvement in the pig iron position in the Midlands, material being bought only in small lots for immediate use. Northamptonshire and Derbyshire irons are being quoted on the same basis as last week, viz., Northamptonshire forge, £3 17s.; foundry, £4 2s. 6d.; Derbyshire forge, £4; foundry, £4 5s to £4 6s. at furnaces. It is increasingly difficult, however, to get these prices, and it is still doubtful whether minimum values have been reached. Although difficulty is found in disposing of the furnace output, particularly forge sorts, stocks in this area are not serious. While the Staffordshire iron trade remains so dull smelters cannot anticipate a brightening up of demand.

Blast-furnace Coke.

As the end of the month draws nearer the question of coke prices exercises more widely the attention of Midland blast-furnace owners. At the end of September coke prices come up for revision, and furnacemen, needless to say, look for a reduction of the present basis. Makers, however, are not altogether in agreement with this view. Recently they have been pressing, though without success, for higher prices. Consumers know that large stocks are available, and give this as a reason for cheaper fuel. Should there be a reduction consumers of pig iron will expect it to be passed on to them.

Iron and Steel Production Costs.

Considerable discussion took place between iron and steel masters on 'Change in Birmingham to-day—Thursday—regarding the rumoured move to reduce the cost of iron and steel production. The complete reorganisation of the industry on the co-operative or combine idea, such as is said to be "the subject of talk," does not, of course, meet with general approval, and in some circles it is queried whether such action would result in as important a fall in the cost of production as advocates of the scheme would have us believe. Opinion in Midland industrial circles would appear to be divided.

£76,000 Sewerage Scheme.

A scheme for the provision of sewerage and sewage disposal works at Lower Gornal, South Staffordshire, has been approved by the Sewerage Committee of the Sedgley District Council. The scheme, which has been outlined by Messrs. Wilcox and Raikes, is estimated to cost £76,000. Application is to be made to the Ministry of Health for sanction to borrow the money; and it is sought to secure a grant from the Unemployment Grants Committee.

Warwickshire Colliery to be Closed.

It is learned with much regret that owing to the impossibility of getting sufficient output to cover the expense of running, and to the heavy loss sustained during the past few years, and more especially during the last six months, Stanley Bros., Limited, have decided to close down the Bedworth Colliery, known as Charity Pit. The pit, which is one of the oldest in Warwickshire, employs about 800 men, and efforts will be made to secure employment for most of them at other pits in the county.

State of Employment.

The steady rise in unemployment in the Midlands area continues, the latest returns showing an increase over the previous week of 1668. The total number of workless at date is 150,344, made up of 107,482 men, 3825 boys, 34,543 women, and 4494 girls. In the Birmingham area the increase continues to be most marked, and the rise of 844 reported a week ago is now followed by one of 521. Short-time workers in this area have also increased in number from 1679 to 1780. The Coventry unemployment figure, which now stands at 5315, shows an increase of 208.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

General Conditions.

ALL the markets here for iron and metals have been very quiet lately, and the price movements have been kept within very small limits. It may be that we are gradually getting down to a "rock-bottom" position, from which, in the course of time, an upward movement may spring. In regard to some of the items this is no doubt the case; but in regard to iron and steel, if Great Britain is now at or near "rock-bottom" prices, then the outlook for her export trade is frightfully bad; for this would mean that the lowest possible prices in this country were some £3 to £4 per ton above the lowest possible prices on the Continent. One is reluctant to believe that this is going to be a permanent condition of the iron and steel trades of the world; for in the end it would be necessary to shut down half or perhaps three-fourths of the British production, and depend entirely upon a protected home trade. It is regrettable even to contemplate such an issue from our present difficulties; but it is no use ignoring the truth that the cost of production in Great Britain is far too high.

Metals.

The faint hope that the acceptance of the Dawes reparation scheme and the "Pact of London" would have a stimulating effect on the copper market seems to have passed off; and the speculators who were trying to use these political influences to initiate a boom in copper must now be rather nervous. There has been no indication yet that the German consumers of copper are ready to make large purchases; but, of course, if the "loan" comes off it is probable that some of it will go towards buying copper for Germany. This possibility has to be considered in estimating the chances of the market; but for one thing the "loan" is still uncertain and may never be realised; and if it be realised, the extra buying of American copper might quickly be neutralised by extra production. Apparently the only substantial reason for expecting better prices for copper lies in the fact that the level of values is low in comparison with almost every other metal. The attitude adopted is that copper cannot go down, but it might go up, and hence the holding of reasonable stocks for prospective work is a safe policy. In the Manchester market only a moderate demand exists for copper ingot. The mechanical engineers of the district are not busy, and it is clear that they are not inclined to buy very much. There have been some locomotive orders placed recently, and these may involve purchases of copper in the near future. Dealers in scrap copper and gun-metal do not admit that there is any improvement whatever in the demand, but say that it is quieter than ever; and in this section of the metal trade one often sees the first indication of a coming revival. It is to be feared that we must be satisfied with quiet and dull trade for another winter. In the market for tin prices have been very variable, and here it is to be noted that sellers are not nearly so confident as they were. A week ago, when talking to them, one got the impression that they expected an advance to £300 per ton; and now their attitude is that, in any case, "the fall cannot go below £230!" This is a change in outlook which is worth thinking about. Of course, the position is far too uncertain for any forecast. Perhaps the troubles in China will give a fillip to the market, and lead to another burst of speculative buying. Spelter has been rather a firmer market of late, but no great interest seems to be taken in it here. The price is, however, comparatively low—except in relation to copper—and there is not much danger of any serious fall. Lead seems to have taken rather an easier turn for the time, and it seems possible that lower prices may be seen, but there is a big consumption, both for the cable trade and the accumulator trade.

Pig Iron.

The demand for foundry iron here is rather intermittent, and the orders obtainable are usually small and for prompt consumption. Apparently ironfounders in Lancashire are not able to obtain far-reaching orders, and they are still very doubtful as to the continuance of the present range of prices. The weakness in the Cleveland market induces them to believe that Manchester prices for the Midland irons have yet to come down; and as there is certainly a chance that at the next revision of the coke prices furnace coke may be cheaper, it may then be possible for Midland ironmasters to accept less for pig iron. This week one can buy Derbyshire No. 3 fairly easily at 92s. 6d. per ton delivered in the district, although it is true that some sellers stick out for 93s. 6d. For forward business over the year, however, it would be necessary to accept 90s. in Manchester, and this Derbyshire makers are not yet prepared to do. There has been some talk of a probable revival in the demand for textile machinery, and, of course, it is well known that many of the cotton mills are in need of new machinery, and are waiting only for a revival in the cotton trade. If this demand comes about it may have a stimulating effect on the buying of foundry iron and might even delay any further fall in prices. Scotch iron sales would, of course, benefit, and at present Scotch pig iron is particularly weak here. There was a sale heard of recently at 104s. per ton delivered, although the usual price is 107s. to 108s. per ton.

Finished Material.

The market here for manufactured steel shows no change on the surface, but it is fairly clear that the weakness is developing. It is now a question of how much a steel maker is willing to lose rather than close down his works; there is, unfortunately, no question of profit. For joists and angles £9 5s. per ton is readily accepted, and for flat bars something under £10. These prices are fully £2 per ton above the quotations for foreign material of the same class. Foreign bar iron seems also

to be finding its way more freely into Lancashire, and, of course, the difference in price is even greater than in steel. There has been a tendency lately to put down the prices for British semi-steel, and it has not come before it was needed.

Scrap.

The market here for scrap of all kinds seems at absolutely dead. Consumers do not want to buy, and can be induced to give orders only by what one may call extravagant concessions. The Sheffield market for scrap steel is practically closed, and dealers here do not know what to offer for this class of material. Some are still paying £3 5s. on trucks in Lancashire, but it certainly appears unsafe to offer more than £3 per ton. The demand for heavy wrought scrap at the Lancashire ironworks has dwindled simply because there is only the smallest possible outlet for Lancashire bar iron at the Association prices. In the market for cast scrap some small business goes on with the ironfounders, but the prices are sagging, and it is now difficult to get 85s. per ton even for good lots of broken machinery scrap.

BARROW-IN-FURNESS.

Hematite.

The position in the hematite iron trade is weaker and the outlook is very bad indeed. Such trade as there is is for small parcels of iron just sufficient to keep customers going. No customer is inclined to stock iron at the present price. There has already been restriction in output at Barrow, two furnaces having been damped down. This course was dictated by the fact that all the output was going into stock. If there is no movement in the iron trade in this district there will probably be further curtailment. Iron is too dear at present, and there is a general demand for cheaper prices. The makers, however, say that they cannot make a profit on the present price. Even a firm which has introduced every saving device and which has got its overhead charges down to the lowest percentage cannot show a margin of profit. The maker protests that railway charges are seriously affecting the cost of production, and that the cost of delivery of the finished material is a further handicap. Take the difference of cost of delivery between Glasgow or Sheffield and Birmingham. Birmingham buyers have to pay 5s. a ton more for their iron than the other mentioned districts. The whole condition of the North-West iron trade is a very serious problem and no one has come forward with a solution yet. In the meantime thousands of men are out of work and receiving the dole. An advanced thinker has suggested that if the men could be kept in work and the dole given to the firm to enable it to compete with other countries there would be a chance of improvement, but we have not arrived at the stage when subsidies can be considered.

Steel.

There is little to say about the steel trade, for apart from the hoop and small section mills, nothing is being done. Neither the rail mills at Barrow nor Workington are working, and the outlook is black. There are a few orders in the market, but local steel makers, despite the fact that they cut prices until there is no profit to be made, are easily beaten in competition with the Continent. Further than that, the world's requirements of steel rails is very small at present, and one mill in the country could supply all that is being inquired for at present. Foundries have a fair amount of work.

Shipbuilding.

It is a comfort to note that both shipbuilding and engineering have nothing to grumble about. Fresh orders for ships will soon be wanted at the rate Vickers are progressing with their contracts. The Orient liner Orama is scheduled to leave Barrow completed on November 15th. Another L.M.S. boat will be launched in a week or two. The L.M.S. steamer Dearne for the Goole-Continental service has been delivered. She was to have a speed of 13 knots, but she attained fourteen and a-half.

SHEFFIELD.

(From our own Correspondent.)

The Heavy Steel Trade.

THE task of writing a review of the position of the heavy steel trade becomes more and more unsatisfactory every week. Things are going from bad to worse. The strike in the Rotherham and Stocksbridge districts continues, with the result that plant capable of producing 20,000 to 30,000 tons of open-hearth steel per week is standing idle, but this does not appear to be causing consumers the slightest difficulty. The works not affected by the dispute can easily provide all the material that is required, although even they are not working full time. In a few cases they have had to increase production owing to the strike, but this has only been necessary to a small extent. Buying has fallen to a minimum, and stocks in the hands of steel users are down to the lowest point. There are some signs that consumers are beginning to discuss future supplies. Not only in crude steel, but in some of the manufactured branches, the position is very depressing. The aggregate output has fallen so low that trading has ceased to be profitable, and financial difficulties are assuming serious proportions.

A Subsidy Suggestion.

A good deal of attention has been drawn to the heavy steel trade of this district during the week by an article in a contemporary, whose special commissioner strongly brought out the seriousness of the situation and the blackness of the outlook. Among those whom he interviewed was Mr. A. O. Peech, chairman of the United Steel Companies, Limited, who put forward the suggestion that the Government should grant a subsidy of 10s. per ton on coal used in the steel industry. The production of 9,000,000 tons of steel a year would require the consumption of 36,000,000 tons of coal, so that the proposed subsidy would amount to £18,000,000 per annum. The amount is large, but it is only equal, according to Mr. Peech's estimate, to what the country is now paying in unemployment dole to steel workers. If the suggestion were adopted, it would have the effect of reducing the cost of steel by £2 a ton, "which is precisely the amount by which foreign manufactured steel is at present undersselling our own." The suggestion has met with a mixed reception in Sheffield. Some manufacturers agree with it, and others favour a tariff. Sir Robert Hadfield does not believe in subsidies, and strongly urges that Labour and Capital should come together, agree upon an industrial peace, and put forward their united efforts to meet the situation. Mr. C. P. Markham, chairman of the Parkgate Iron and Steel Company and of the Staveley Coal and Iron Company, does not favour the proposal, but urges that 6s. per ton could be taken off the price of coal by the collieries working longer hours.

Railway and Tramway Work.

There is still a large amount of work on hand in that side of the steel trade which caters for railway and tramway supplies. The axle, tire, spring and buffer shops are fairly well employed on work for the home railway companies, but they continue to complain of the paucity of orders received from overseas. A similar state of things prevails in the shops where special tramway track material is made. A good number of new railway orders have been given out during the past week, and the Sheffield firm of George Turton, Platts and Co., Limited, has secured one of them. It has come from the East Indian Railway Company, and is for 6500 large complete buffers to be made on the firm's weldless forged steel principle. This contract, with those already in hand, will keep the new Meadow Hall works of the company in full operation night and day for several months.

Engineering and Tools.

The reports as to the continued improvement of the country's engineering trade are very encouraging, and are being accompanied by an increased call for the tools made by the lighter section of the Sheffield steel trade. The long spell of depression which the machine tool branch has suffered from appears to be lifting. There is an improvement in the demand for steel castings, and a fairly satisfactory state of things prevails at several of the foundries. The crucible steel trade continues to gain strength, but, while a few firms are fairly well situated, others are still very short of work, and the general condition is very poor, output being much inferior to that of the days when the industry was enjoying full prosperity. This is hardly to be wondered at, seeing that trade with the Continent, which was formerly a large proportion of the whole, is heavily handicapped by the state of the exchanges. There is a steady increase in the call for the ferro-alloys used in special steels, and the motor trade continues to take good supplies.

The New Tanks.

An interesting sight was witnessed in Sheffield the other evening, when an improved tank, made by Vickers Limited, was given a trial run on the hilly roads in the Brightside district. The tank is one of many that are intended for India. It is designed to develop a speed of about 20 miles per hour, and can be steered and turned with ease. It can also climb an incline of 45 deg. The machine is propelled on the caterpillar principle, the motor being an Armstrong-Siddeley 90 horse-power engine, which is air cooled by means of powerful fans. The tank accommodates a gun crew of four and a driver, and has a gun mounted in the turret.

Cutlery and Plate.

The output of cutlery is large, but so many firms are engaged in the trade that few of them are able to work on a remunerative basis. The demand is chiefly for stainless steel table knives, and there is also a fair trade in scissors and surgical instruments, but the pen and pocket knife and razor branches are quiet, especially the latter. In the silver and electro-plate trade the production of spoons and forks continues on a large scale, and good orders for sterling silverware and canteens of table plate are occasionally booked. The hollow-ware branch generally is very quiet, and the mass production methods of Birmingham are imposing severe competition on Sheffield. Some expansion in colonial trade is reported, but Australia and New Zealand are buying much more keenly than they did before the war, and competitive prices have to be quoted if orders are to be obtained. There is some improvement in business with South Africa, South America and Scandinavia.

Colliery Progress.

The directors of the Staveley Coal and Iron Company, in their annual report, state that both shafts of the new Dowell Colliery have been carried down to the coal, which is of satisfactory quality, and the opening out of the workings is proceeding. For the purpose of developing the lower seams at Barlbrough, Markham and Warsop hard coal pits, it has been decided to deepen the existing shafts, and a beginning has already been made. In order to increase the generation of electrical energy by the utilisation of waste gas from the blast-furnaces at the company's Devonshire Works, an agreement has been entered into for the supply and erection of a gas engine of greater proportions than any now in this country, and preparations are being made for its erection. The Bolsover Colliery Company is carrying out developments in the Southwell district, which will necessitate the building of many houses, and the Southwell Rural Council has decided to apply for sanction to borrow £40,500 for the housing subsidies. The first electrically driven winding engine to be installed in a South Yorkshire pit was set in motion last week at No. 2 shaft of Harworth Colliery.

Spalding Electricity Scheme.

There is a prospect of a scheme for the electric lighting of Spalding being proceeded with. It is to cost £15,000, and has been in abeyance for a considerable time, but it can now be put into operation automatically, consequent upon the fact that the Ministry of Health has approved of a £50,000 sewerage scheme for the town. As power will have to be provided for the sewage farm, it is estimated that the electric light and power scheme will be self-supporting from the start. This is due to the fact that the day load can be given to the sewage air compressors, and the evening load to the town for light, &c. The completion of the scheme is not a matter of the immediate future, however. It is not expected that powers can be obtained from the Electricity Commissioners for six months, or that the electricity will be available for two years.

Improvements at Scarborough.

Further important developments are to be carried out by the Scarborough Town Council on the north side of the town. The promenade is to be lengthened by 400ft., and the cliff behind is to be terraced so as to form an approach to the ravine known as Hodgson's Slack, which it is intended to open out as an amusement centre. The work will be spread over three years, and the estimated cost is £14,700.

NORTH OF ENGLAND.

(From our own Correspondents.)

Cleveland Iron Trade.

THERE are no signs of any material improvement in the Cleveland pig iron trade, and the prospects for the next few weeks are not at all encouraging. With the opinion prevailing that the worst of the depression has not yet been experienced, consumers are naturally acting with much caution. In almost all branches sales are confined to small transactions to meet early requirements. Home trading, as well as overseas business, is on a trifling scale, in comparison with what is usually experienced at this time of the year, when arrangements to provide for autumn requirements are generally made. This year home needs are on an extremely discouraging scale. The market for ferro-manganese is probably the worst hit. Competition is so keen that prices have been depressed to an unprofitable level, with the result that Bolckow, Vaughan and Co., Limited, have followed the example of the Carlton Ironworks and ceased the production of this class of iron, the one furnace producing ferro-manganese being changed over to Cleveland iron. This makes a total of thirteen blast-furnaces producing Cleveland foundry iron. There is still cheap foreign iron on offer, and some more iron is coming into this district from abroad; but, on the other hand, there are a few more European inquiries about for local iron, and makers are not disposed to indulge in any serious price cutting. For small lots they still quote 82s. 6d. per ton for No. 3 Cleveland pig iron, but business can be done at 82s. No. 1 is scarce, and keeps firm at 87s. 6d., but No. 4 foundry and No. 4 forge are down to 81s. and 80s. per ton respectively.

Hematite Pig Iron.

The East Coast hematite pig iron trade is still very depressed. It shares in the adversities of the steel trade, and the absence of any foreign demand accentuates the depression. Mixed numbers can now be bought at 90s. per ton, a drop of 1s. on the week, although some makers are still quoting 91s. per ton.

Ironmaking Materials.

There is a state of complete stagnation in the foreign ore trade, and the offer of very low freights fails to stimulate business, best Rubio ore remaining at 22s. 6d. per ton c.i.f. Tees. Good medium furnace coke is steady at 26s. per ton delivered at the works.

Manufactured Iron and Steel.

The manufactured iron and steel trade shows no signs of recovery. Indeed, with the shipbuilding trade on the North-East Coast going from bad to worse, there seems no immediate prospect of any greater activity for steel manufacturers. Moreover, there is a lot of cheap foreign semi-steel on the market, and considerable quantities are still coming into the district. The only active section is that of sheet making, and manufacturers have enough orders on hand to keep them fully employed to the end of the year. Prices are unchanged.

The Coal Trade.

The depression in the Northern coal trade is, if anything, more pronounced, and operators are apparently not taking the slightest interest in the market. Indeed, the position has not been so gloomy for many years past, and producers are passing through a very trying time. The number of collieries that are closing down is increasing each week, and there are now between 5000 and 6000 idle miners in Northumberland, with practically the whole of the remainder on short time. In Durham a similar distressing experience is recorded. All interested in the coal trade appear to take a very gloomy view of the position, and at present it has to be admitted that there are no signs of any recovery. The general lack of export orders is about the worst for many years past, and is traceable chiefly to deliveries of German reparation coals to Allied countries. There is also a probability of German competition becoming more acute, owing to the reduction in coal prices and freight rates, which come into operation at the beginnmg of November. There is a much larger supply of coal on the Northern market than can be disposed of, and holders continue to press their holdings on the market, with the result that prices are a matter of negotiation. Even then, with abundant German supplies at the ports at prices below British values, there is the

utmost difficulty in effecting sales. Nearly all classes of coal have eased in price during the week, the one outstanding exception being steam smalls, which show a rather firmer tone. The coke trade is quiet, but makers hold for recent values.

Cleveland Mining Industry.

Several matters affecting the Cleveland mining industry were under consideration at a conference this week between the mineowners and the Executive Committee of the Cleveland Miners' Association. The men sought to ascertain what steps could be taken jointly or otherwise to effect an improvement in the industry. It was suggested that the owners and workmen might jointly approach the royalty owners and the railway company, with a view to obtaining some relief to assist the trade in its present deplorable condition. With regard to a claim before the meeting for increased wages, the owners intimated, whilst deeply sympathising with the men in the unfortunate position in which they were placed, that it was impossible to make any concession which would add even a fractional increase to present costs.

SCOTLAND.

(From our own Correspondent.)

Poor Prospects.

GENERALLY speaking, the trade outlook is unsatisfactory. The past week has been dull in almost all directions, and markets have been very slow and uncertain. Conditions which have governed business for some months back are still very much in evidence. Makers continue to reiterate the impossibility of easier quotations, while consumers, on the other hand, are apparently determined to buy only on a day-to-day principle so long as prices are high and trade so indifferent. The possibility—in fact, one might almost say the probability—of increased continental competition has not improved matters and a continuance of present conditions must result in a further curtailment of output.

Pig Iron.

The prevailing depression in the pig iron market is unrelieved. Business is very intermittent, and neither home nor export demands are strong enough to promise any early increase in trade. The output is very low at present, but there is every prospect of a further reduction of the small number of furnaces in blast. Prices are nominally unchanged, but an arrangement could easily be made if a decent order were in prospect.

Steel.

The current demand for steel plates and sections is most disappointing. The shipyards are not exactly busy, but it seems hardly possible that local makers are receiving anything like the former proportion of the orders which must be forthcoming from the work on hand. At any rate, specifications for plates and sections are extremely slow, and prices are unchanged. Steel sheet makers are, however, fully employed, but are not booking so many orders as they were a month or two ago. Galvanised varieties are in moderate request. The market for scrap is a poor one, and until more activity is apparent at the steel works, little improvement is likely.

Bar Iron.

The bar iron works just manage to carry on, but business is very irregular. Practically nothing is being bought on home account, while the export turnover is very spasmodic. Prices are unchanged. Re-rolled steel is a shade busier, but no permanent improvement is anticipated.

Coal.

While it might be too much to say that the coal trade is actually dull all round, it is certain that the present turnover is far below normal, and prospects are uninviting. Foreign importers are buying very cautiously, and there is no sign of any disposition to realise requirements. Exporters, too, are not prepared to pay the enhanced prices quoted by the collieries for forward delivery. The turnover, therefore, is very restricted, and the probability of severe German competition cannot be ignored. Consequently, the outlook is uncertain, and far from satisfactory. Transactions of a day-to-day nature are general, and a considerable proportion of the business is being done through second hands. The collieries, therefore, are very short of new business, and with a few exceptions prices show a weakening tendency. Lanarkshire splints and navigations have a fair turnover, and Fifeshire steams move freely, but almost all other descriptions of round fuel are plentiful and weak. Treble nuts are comparatively busy in all districts, and double nuts in the Lothians, but smaller sizes are almost a glut on the market. Shipments from the Clyde were augmented by a number of bunkering orders, and maintained a good average, but the returns from the Lothians and Fifeshire showed a considerable decrease. Aggregate shipments amounted to 250,724 tons, against 285,247 tons in the preceding week and 350,242 tons in the same week last year. The home market is a shade busier in the household descriptions, but the industrial demand continues far below normal.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Outlook.

INTEREST in this district is practically confined to the welfare of the coal industry. In other directions there is no feature or news of any note. Attention is principally focussed on the coal trade, for the reason that it is the mainstay of the district, but, unfortunately, it is in a very bad way. The position on all hands is recognsed as an extremely serious one, alike for employers and workmen. Numerous collieries are undoubtedly losing thousands of pounds a month in their effort to keep going, and it is no exaggeration to say that it would be a rarity to find a single steam colliery working at full output. Even the best and most up-to-date equipped undertakings are finding extreme difficulty in maintaining regular employment, as the demand for coals is so meagre. Half the miners are only working two or three days a week, and many thousands are totally unemployed owing to the closing down of pits. The conditions are such that it is impossible to avoid striking a pessimistic note, not only as regards the present, but also the future. There has been no improvement in the demand from any quarter, and buyers are continuing to bear the market, in order to make business, which appears to be only possible on the basis of prices lower than those which have previously been done. The tonnage situation is also unsatisfactory, and there is a shortage of supplies for the Mediterranean in particular, with the result that rates are advancing, much to the chagrin of those exporters who have recently taken business at the comparatively low figures ruling, so that many of them may easily make a loss.

Coalfield Items.

It is impossible in the circumstances to go into any detail regarding the situation in the coalfield, as there is no district, excepting that of the anthracite section, which has not its own trouble, and where the conditions cannot accurately be described as somewhat parlous. Collieries which are working to-day may easily be idle to-morrow, and when the stoppage comes the men cannot be certain for how long they will be unemployed. Naturally the miners are in a despondent mood, and while the real cause for the existing depression is the anæmic condition of trade throughout the world, many of the leaders are laying the trouble at the door of the employers and blaming the capitalistic system in general. In the Rhondda area, apart from the temporary suspension of work at pits, there is the fear that there may be further trouble in the district, as allegations are made that members of the Federation have been victimised. The whole question was discussed at a meeting of the Miners' Council for the Rhondda on Monday. There was a strong feeling that the men should immediately give fourteen days' notice to terminate contracts, but fortunately the advice of the leaders prevailed, and a strong appeal was made that the Central Executive should be given a further opportunity to consider the whole report and position. In the case of the Windsor Colliery, the miners have been warned by the directors that there must be less absenteeism on Saturdays, otherwise the owners will be compelled to close the pits, which for many months have been run at a loss. In the Rhymney Valley there is one item of good news, this being that the Mardy pit, which was to have been closed down definitely last Saturday, is to continue working. The Powell Duffryn Company has withdrawn the notices, which affected about 1000 men. Another encouraging item is that the dispute at the Tarreni Colliery in the Swansea Valley has been settled. This colliery, which employs 700 to 800 men, has been idle since last January.

Miners' Wage Agreement.

A coalfield conference was held at Cardiff on Tuesday last to receive the report of the Miners' Executive upon the negotiations which have been in progress with the employers' representatives. All efforts to arrive at an agreement have so far failed, and therefore the leaders have withheld their signatures to the South Wales district agreement. The report stated that at every meeting the owners' chairman was persistent in seeking to impress upon the workmen's representatives that any further increase in cost at the collieries would have a disastrous effect upon the industry, and result in the closing down of many collieries. Further, the only grade of workman they felt compelled to recognise as entitled to consideration by the terms of the agreement was the skilled, competent craftsman. The report concluded with the remark that it was unfortunate that it had been necessary to endeavour to secure adjustments in the rates of wages at a time when apparently the whole economic conditions of the industry were in a very unsatisfactory state. The Executive recommended that the workmen's representatives should be allowed to sign the new agreement, but the conference declined to act on this advice without the sanction of the rank and file, and it therefore decided to refer the matter to the miners' lodges for decision. The replies are to reach the miners' office by next Tuesday.

Dry Dock Dispute.

There is no change in the situation as it affects the members of the Amalgamated Engineering Union employed in the ship-repairing industry of this district. The members are still idle, and no move has been made to bring about a settlement.

Current Business.

The demand for steam coals is very quiet, and the market is easy for almost all descriptions. Even the best Admiralty large coals, which have been the steadiest section of the market, are not so good, and the top price quoted for these is 28s. 6d., although supplies can be secured at less money. Small coals are plentiful, especially cargo sorts. Anthracite coals are, however, firmer, and collieries are very fully stemmed for the next month or two. Coke and patent fuel are unchanged.

WORK has been started on strengthening the bridge at the junction of New Bridge-street and Clarence-street, Newcastle, where the road runs over the London and North-Eastern Railway, in order to cope with the great increase in the weight of traffic since the bridge was built. The whole of the floor is to be replaced and during the three months which the work will occupy traffic is to be diverted.

LAUNCHES AND TRIAL TRIPS.

BIRCHBANK, twin-screw motor vessel; built by Harland and Wolff, Limited, to the order of the Bank Line, Limited; dimensions, 434ft. by 53ft. 9in. by 37ft.; 5200 gross tonnage. Engines, two sets of six-cylinder Diesel; constructed by the builders; delivered, September 4th.

RAHANE, steamer; built by Swan, Hunter and Wigham Richardson, Limited, to the order of the Rahome Steamship Company, Limited; dimensions, 248ft. by 43ft. by 25ft. Engines, constructed by the North-Eastern Marine Engineering Company; trial trip, September 5th.

FOREST GATE, single-screw steamer; built by Barclay, Curle and Co., Limited, to the order of the Forest Shipping Company; dimensions, 260ft. by 39ft. 6in. by 19ft. 10in. Engines constructed by J. G. Kincaid and Co.; trial trip, September 6th.

BARRINGTON COURT, single-screw steamer; built by Workman, Clark and Co., Limited; to the order of Haldin and Co., Limited; dimensions, 396ft. 6in. by 53ft. by 26ft. 6in.; 4900 gross tonnage. Engines, vertical inverted direct-acting surface-condensing, triple-expansion; constructed by the builders; trial trip, September 10th.

SLIEDRECHT, motor ship; built by Rotterdamsche Droogdok Maatschappij, to the order of Stoomvaart Maatschappij "de Maas," of Rotterdam; dimensions, 370ft. by 53ft. by 26ft. Engines, six-cylinder Harland and Wolff motor; trial trip, September 10th.

H.P. and H.C., No. 6, twin-screw hopper barge; built by Irvine's Shipbuilding and Dry Docks Company, Limited, to the order of Hartlepool Port and Harbour Commissioners; dimensions, 132ft. by 28ft. by 12ft.; 490 tons deadweight. Engines, twin-screw compound, 12in. and 27in. by 20in. stroke; constructed by W. Sisson and Co., Limited; launch, September 11th.

ARAGUAYA, twin-screw passenger liner; overhauled by Harland and Wolff, Limited, to the order of the Royal Mail Steam Packet Company; dimensions, 515ft. by 61ft. by 34ft.; 10,200 gross tonnage; left Belfast September 11th.

FOREST HILL, single-screw steamer; built by Barclay, Curle and Co., Limited, to the order of the Forest Shipping Company; dimensions, 260ft. by 39ft. 6in. by 19ft. 10in.; to carry 1600 gross tonnage. Engines, triple-expansion, constructed by J. G. Kincaid and Co.; launch, September 11th.

STATENDAM, liner; built by Harland and Wolff, Limited, to the order of the Holland-America Line; dimensions, 697ft. by 81ft. by 53ft. 6in. Engines, two sets of single reduction geared turbines; constructed by the builders; launch, September 11th.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

WE are requested to say that Hopkinson Induction Motors has removed from West Brompton to Willesden-lane, North Acton, London, W. 3.

WE are informed by Smith Brothers and Co. (Hyson), Limited, that they have erected a new fitting shop and extended their machine shops at their Nottingham works.

WE are asked to state that, pending other arrangements, all communications of a personal character for Mr. A. Shearer, M.I.N.A., late manager with Sir W. G. Armstrong, Whitworth and Co., Limited, and Vickers, Limited, Turkish Arsenal and Docks, Golden Horn, Constantinople, should be addressed to "Edgehill," Drumchapel, Glasgow.

CONTRACTS.

THE CLYDE CRANE AND ENGINEERING COMPANY, Limited, of Mossend, near Glasgow, informs us that it has been successful in securing an important contract for level luffing cranes for the Great Western Railway Company. The cranes are to be erected at the Alexandria Dock, Newport.

WE learn that James Pollock, Sons and Co., Limited, 3, Lloyd's-avenue, London, E.C. 3, have received a contract to build a stern wheel steam-propelled combined suction and grab dredger to their own designs, for South American clients. This vessel will have a length of 130ft. by 27ft. by 6ft. moulded depth.

VICKERS LIMITED, Hydro-electric Department, has received an order from the Government of New Zealand for two large water turbines, each with an output of 12,650 horse-power. These turbines will be installed at Lake Coleridge in the South Island and will provide power for Christchurch, Ashburton, Timaru, and district. The turbines will be constructed at Barrow-in-Furness.

HARLAND AND WOLFF, Limited, Liverpool, has placed an order with L. Gardner and Sons, Limited, Patricroft, for a 96 brake horse-power four-cylinder Gardner heavy oil engine, to be installed in a superintendent's launch, at present being built at Harland and Wolff's yard. The dimensions of this launch are 55ft. long by 10ft. 9in. beam. It is being built to the order of Andrew Weir and Co., and is destined for South America.

GOODWIN, BARSBY AND CO., Limited, Leicester, inform us that they have received further repeat orders from the Roscommon County Council and the Limerick County Council for patented Acme stonebreakers. The orders now in hand represent the third and fourth machines ordered by the Limerick County Council within the last four months. The firm has also received an order for one of its 20in. patented Acme granulators from the Isle of Man Highways Board, and also from the Roxburgh County Council.

HIS MAJESTY'S TRADE COMMISSIONER at Cape Town reports that the Town Council at Beaufort West, Cape Province, is calling for tenders to be presented by October 31st, for power station plant for its electric lighting scheme. A copy of the specification, general conditions of tender and explanatory blue prints, can be inspected by British firms at the Department of Overseas Trade (room 52), 35, Old Queen-street, London, S.W. 1.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS—COMPETITION RESULT.—A competition was arranged by the Institution of Heating and Ventilating Engineers early in the year to encourage education in the industry. The result has now been issued by the Council of the Institution. Interest seems to have been awakened in different parts of the world, and the "Lumby" Premium, £10 10s., presented by Lumby's Limited, of Halifax, was secured by an American, Mr. V. Nekrassoff, of Philadelphia, U.S.A. The "Sirocco" Premium, £10 10s., presented by Davidson and Co., Limited, Belfast, was awarded to Mr. Victor Matthews, of Bristol; and the "Preston" Premium, £5 5s., presented by Mr. J. R. Preston, of Mumford, Bailey and Preston, Limited, London, was awarded to Mr. H. A. Stirzaker, of London.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	17/6 to 24/-
(1) Spanish	23/-
(1) N. African	23/-
N.E. COAST—	
Native	—
Foreign (c. ...)	22/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	4 15 0	—
No. 1 Foundry	4 16 3	—
No. 3 Foundry	4 11 3	—
N.E. COAST—		
Hematite Mixed Nos.	4 10 0	4 10 0
No. 1	4 10 6	4 10 6
Cleveland—		
No. 1	4 7 0	4 7 0
Silicious Iron	4 7 0	4 7 0
No. 3 G.M.B.	4 2 0	4 2 0
No. 4 Foundry	4 1 0	4 1 0
No. 4 Forge	4 0 0	4 0 0
Mottled	—	—
White	—	—
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	9 2 6	—
North Staffs. Forge	4 2 0	—
„ „ Foundry	4 10 0	—
(3) Northampton—		
Foundry No. 3	4 2 6	
„ Forge	3 17 0	—
(3) Derbyshire—		
No. 3 Foundry	4 5 0 to 4 6 0	
Forge	4 0 0	—
(3) Lincolnshire—		
No. 3 Foundry	4 10 0 to 4 12 0	
No. 4 Forge	4 12 6 to 4 15 0	
Basic	4 5 0 to 4 10 0	
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	5 10 0 (a)	—
	5 15 0 (b)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	12 10 0	—
Best „	—	—
N.E COAST—		
Common Bars	12 10 0	—
LANCS —		
Crown Bars	13 0 0	—
Second Quality Bars	12 0 0	—
Hoops	15 0 0	14 15 0
S. YORKS.—		
Crown Bars	13 10 0	—
Best „	14 0 0	—
Hoops	15 0 0	—
MIDLANDS—		
Crown Bars	12 15 0 to 13 0 0	
Marked Bars (Staffs.)	15 0 0	—
Nut and Bolt Bars	12 0 0	—
Gas Tube Strip	13 5 0	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	13 10 0	—
Ship Plates, ½in. and up	10 5 0	—
Sections	10 0 0	—
Steel Sheets, 3/16in. to ½in.	12 10 0	—
Sheets (Gal. Cor. 24 B.G.)	—	18 10 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	9 15 0	—
Angles	10 0 0	—
Boiler Plates	13 10 0	—
Joists	10 0 0	—
Heavy Rails	9 0 0	—
Fish-plates	13 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	9 10 0	—
Soft Billets	8 10 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	9 5 0†	—
Light „	9 10 0 to 10 0 0†	
Billets	8 10 0 to 12 0 0†	
MANCHESTER—		
Bars (Round)	10 5 0 to 10 15 0	
„ (others)	10 0 0 to 10 2 6	
Hoops (Best)	15 5 0	15 0 0
„ (Soft Steel)	13 15 0	13 10 0
Plates	10 0 0 to 10 5 0	—
„ (Lancs. Boiler)	13 10 0	—
SHEFFIELD—		
Siemens Acid Billets	12 10 0	—
Bessemer Billets	13 0 0	—
Hard Basic	9 10 0	
Intermediate Basic	9 0 0	
Soft Basic	8 5 0 to 8 10 0	
Hoops	12 10 0 to 13 0 0	
Soft Wire Rods	11 0 0 to 11 10 0	
MIDLANDS—		
Small Rolled Bars	9 7 6 to 10 0 0	
Billets and Sheet-bars	7 10 0 to 7 15 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	18 5 0	—
Angles	9 10 0 to 10 0 0	
Joists	9 10 0 to 10 0 0	
Tees	10 10 0 to 11 0 0	
Bridge and Tank Plates	10 10 0	—
Boiler Plates	14 0 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	23/6
Block Tin (cash)	231 15 0
„ (three months)	234 0 0
Copper (cash)	62 0 0
„ (three months)	63 0 0
Spanish Lead (cash)	32 10 0
„ (three months)	32 0 0
Spelter (cash)	33 5 0
„ (three months)	32 17 6
MANCHESTER—	
Copper, Best Selected Ingots	67 0 0
„ Electrolytic	68 0 0
„ Strong Sheets	93 0 0
„ Tubes (Basis price)	0 1 1½
Brass Tubes (Basis price)	0 1 0
„ Condenser	0 1 2½
Lead, English	34 15 0
„ Foreign	33 5 0

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/8½ per lb.	
Ferro Tungsten	1/4½d. per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£24 0 0	8/-
„ 6 p.c. to 8 p.c. „	£23 10 0	7/9
„ 8 p.c. to 10 p.c. „	£23 0 0	7/6
„ Specially Refined		
„ Max. 2 p.c. carbon	£43 0 0	16/-
„ „ 1 p.c. „	£52 0 0	17/6
„ „ 0.75 p.c. carbon	£58 0 0	20/-
„ „ carbon free	1/5 per lb.	
Metallic Chromium	4/2 per lb.	
Ferro Manganese (per ton)	£15 for home, £15 for export	
„ Silicon, 45 p.c. to 50 p.c.	£12 2 6 scale 5/- per unit	
„ „ 75 p.c.	£17 17 6 scale 6/- per unit	
„ Vanadium	18/9 per lb.	
„ Molybdenum	8/- per lb.	
„ Titanium (carbon free)	1/2 per lb.	
Nickel (per ton)	£155	
Cobalt	10/6 per lb.	
Aluminium (per ton)	£130	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	18/9
„ „ Ell	20/-
„ „ Splint	22/- to 24/6
„ „ Trebles	22/-
„ „ Doubles	18/9
„ „ Singles	18/-
AYRSHIRE—	
(f.o.b. Ports)—Steam	18/9
„ „ Splint	22/-
„ „ Trebles	22/-
FIFESHIRE—	
(f.o.b. Methil or Burnt-island)—Steam	16/- to 19/9
Screened Navigation	26/-
Trebles	24/-
Doubles	18/3
Singles	15/9
LOTHIANS—	
(f.o.b. Leith)—Best Steam	18/-
Secondary Steam	17/-
Trebles	23/3
Doubles	19/-
Singles	15/9

ENGLAND.

	Inland.
(8) N.W. COAST—	
Steams	28/6
Household	45/- to 58/4
Coke	33/6
NORTHUMBERLAND—	
Best Steams	19/- to 19/6
Second Steams	17/6
Steam Smalls	10/6
Unscreened	15/6 to 17/-
Household	23/6 to 25/-
DURHAM—	
Best Gas	21/6 to 22/6
Second	17/- to 18/-
Household	23/6 to 25/-
Foundry Coke	26/- to 26/6
SHEFFIELD—	
Best Hand-picked Branch	32/- to 35/- —
Barnsley Best Silkstone	26/- to 28/- —
Derbyshire Best Brights	26/- to 28/- —
„ „ House	23/- to 25/- —
„ „ Large Nuts	21/- to 25/- —
„ „ Small „	15/- to 17/6 —
Yorkshire Hards	21/6 to 22/6 —
Derbyshire „	21/- to 22/- —
Rough Slacks	12/6 to 15/6 —
Nutty „	12/- to 14/- —
Smalls	6/- to 8/6 —
Blast-furnace Coke (Inland)*	— —
„ „ (Export)	f.o.b. 26/- to 27/-

(9) SOUTH WALES.

CARDIFF—	
Steam Coals :	
Best Smokeless Large	28/- to 28/6
Second „ „	26/- to 27/-
Best Dry Large	26/- to 26/6
Ordinary Dry Large	25/- to 26/-
Best Black Vein Large	26/- to 26/6
Western Valley „	25/6 to 26/-
Best Eastern Valley Large	25/- to 25/6
Ordinary „ „	24/- to 25/-
Best Steam Smalls	15/6 to 16/-
Ordinary „	13/- to 15/-
Washed Nuts	25/- to 27/-
No. 3 Rhondda Large	27/- to 28/-
„ „ Smalls	20/- to 22/-
No. 2 „ Large	23/- to 24/-
„ „ Through	19/- to 21/-
„ „ Smalls	14/- to 15/-
Foundry Coke (export)	45/- to 52/6
Furnace Coke (export)	30/- to 32/6
Patent Fuel	27/- to 29/-
Pitwood (ex ship)	29/- to 29/6
SWANSEA—	
Anthracite Coals	
Best Big Vein Large	52/6 to 55/-
Seconds	45/- to 47/6
Red Vein	33/- to 35/-
Machine-made Cobbles	57/6 to 60/-
Nuts	55/- to 62/6
Beans	40/- to 42/6
Peas	24/- to 26/-
Breaker Duff	11/- to 11/6
Rubbly Culm	12/6 to 13/-
Steam Coals :	
Large	23/- to 24/-
Seconds	22/- to 23/-
Smalls	14/- to 18/-
Cargo Through	18/- to 20/-

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow.

(8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b.

* For blast furnaces only, 21/- to 25/-; open market, round about 24/- at ovens. † Latest quotations available. (a) Delivered Sheffield or Glasgow. (b) Delivered Birmingham.

French Engineering Notes.

(From our Correspondent in Paris.)

Foreign Competition.

THERE is a general impression that the iron, steel and engineering trades have reached a parting of the ways when their future may be made or marred by the events of the next few months. The question of fuel supplies is not the only one that is dominating the situation, for while this country is dependent upon Westphalia for coal and coke and will find itself severely handicapped if the fuel is not obtainable in sufficient quantities at reasonable prices, the cost of production is further influenced by the steady increase in the cost of living. As wages have to be advanced proportionately employers are making a very strong stand against any further increase in the belief that the continuous upward movement will place them in such a position that they will be unable to compete for foreign trade. Despite the fact that wages are generally about 250 per cent. above those paid before the war, it would appear that, taking into account the exchange rate, they are still appreciably below the wages paid in Great Britain; but as the purchasing power of the franc is higher in France than it is abroad the difference is not so great as it seems, and, on the whole, the constant inflation justifies the fear that an improvement in the exchange rate will place French manufacturers in a less satisfactory position than their competitors abroad. The cost of living appears to have reached its culminating point in most other countries, while here it is still increasing. The situation has become so disquieting that the Government is making further efforts to bring down the cost of commodities. The same thing has been done for some years past, but nothing has come of the various decrees to suppress illicit profits, and the only sure thing at the present moment is that manufacturers are determined to resist all claims for higher wages, convinced, as they are, that higher wages merely imply higher living costs. Unless economies can be effected in production any considerable improvement in money values will certainly open the way to foreign competition.

Free Port at Budapest.

The construction of the free port on the Danube at Budapest is being actively carried out by the French group, including Schneider and Co., of Creusot, with capital provided by a French company, which participates in the enterprise to the extent of 40 per cent., while the Hungarian State has an interest of 60 per cent. in return for the fifty years' concession accorded to the company. The free port is only part of the considerable work that is being undertaken to make Budapest the great port of transit on the Danube. At the end of the island of Csepel the State has acquired a very large area of land which will be available for any future extensions that may have to be carried out, and barrages and locks have been constructed to ensure a constant water level in the new port. Arrangements are now being made for the port equipment. Along the banks of the Danube wharves are being built and basins constructed. All this is intended to deal with a considerable traffic, and in order to facilitate the transit of goods and make Budapest the great port of Central Europe a "free zone" has been created where an entirely new port is being laid out and equipped by the French company. Two basins are being completed, one covering 10 acres for the oil traffic and the other of 27 acres for grain, coal, minerals, timber, and other goods. Grain elevators having a capacity of 30,000 tons, which will be increased eventually to 50,000 tons, will deal with 100 tons an hour. The elevators and other gear, as well as the rest of the port equipment, will be worked electrically with current supplied by the town of Budapest.

Tidal Power.

The publication of the decree authorising the State to grant a concession for the construction of a tidal power generating station at Aber Vrac'h, near Brest, to the cost of which the State will contribute in a large proportion, marks the beginning of the practical stage in the carrying out of an experimental undertaking which, it is hoped, will provide definite data showing the possibility or otherwise of utilising the tides for the production of electrical energy. While the Aber Vrac'h scheme is mainly experimental, it is intended to pay its own way and will provide Brest with current by a high-tension main of 30,000 volts, and to ensure a regularity of supply the tidal power plant will work in conjunction with a power station utilising a head of water provided by a barrage across the mouth of the river Diouris. The Aber Vrac'h barrage will be 150 m. long and from 12 m. to 24 m. wide, and will be composed of three concrete caissons containing the reversible turbines and alternators. A sluice gate will permit of the basin above the barrage being filled by the rising tide. The turbines will run from nine to eleven hours each tide. A great deal of attention has been given to turbines capable of resisting the action of sea water in view of the Aber Vrac'h application, and spare chambers are reserved in the barrage for carrying out experiments with different kinds of turbines. The idea is to attempt to find a solution of all the problems that appear to present difficulties in the utilisation of tidal power, and if they can be overcome and the idea of employing the tides for power distribution is found practicable, it is probable that other installations will be authorised along the Atlantic coast in estuaries or bays where the tides have a sufficient amplitude. The Aber Vrac'h power station will not ensure an uninterrupted supply of current, and this will be provided for by the Diouris river barrage with a head of from 8 m. to 24 m. and actuating four turbines, each of which will develop from 75 horse-power to 1200 horse-power according to the tides. A number of pumps will be employed to return some of the river water below the barrage to a reservoir above which will serve as a regulator. The Diouris station will continue the supply of current when the Aber Vrac'h plant is stopped at low tide, and for the rest of the time the Diouris station will only produce what is necessary for driving the pumps and auxiliary machinery.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

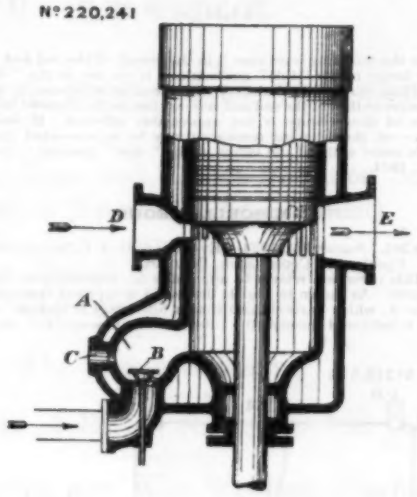
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

220,241. February 20th, 1924.—SCAVENGING TWO-STROKE ENGINES, G. J. Lugt, 66, de Lairessestraat, Amsterdam, Netherlands.

In order to improve the working conditions at the piston-rod

Nº 220,241



end of a double-acting two-stroke engine the inventor provides a combustion chamber A which is fitted with a scavenging air valve B and a fuel inlet C. The main scavenging air inlet is marked D, while E is the exhaust.—*August 14th*, 1924.

SWITCHGEAR.

219,717. February 27th, 1923.—IMPROVEMENTS IN OR RELATING TO PROTECTIVE ARRANGEMENTS FOR ELECTRIC DISTRIBUTION SYSTEMS, Switchgear and Cowans, Limited, and George Henry Neep, both of Elsinore-road, Old Trafford, Manchester.

In this specification a protective system is described for electric distribution systems in which all the conductors are normally insulated from earth. A three-phase scheme is illustrated. Each conductor A, B, C has a primary winding of a leakage current transformer in series with it, as shown at D E F. The secondary winding of the transformer is con-

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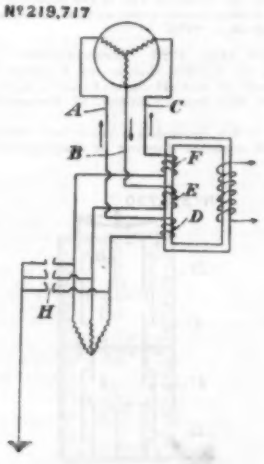

nected with the trip coil of the circuit breaker or with a relay arranged to initiate the operation of the trip coil. Spark gaps H are connected between the cable cores and earth as shown. If the insulation between any of the phases and earth should become defective the electrostatic pressure across the spark gaps connected to the healthy phases will cause an arc to bridge the gaps and provide a return path for the current, which will then leak from the faulty phase. The balance of the transformer is upset, and a current is induced in the secondary winding, thus causing a flow of current through the trip coil or relay of the circuit breaker.—*July 28th*, 1924.

TRANSMISSION OF POWER.

219,884. February 2nd, 1924.—AN IMPROVED METHOD IN OR RELATING TO CENTRIFUGAL FRICTION CLUTCHES, Thomas Broadbent and Sons, Limited, of Central Ironworks, Huddersfield, Yorks, and Archibald Henry Weir, of the same address.

The driving member A of this clutch carries a spider or block B. In recesses on the periphery of this block there are shoes C faced with friction material D, and capable of being thrown outwards by centrifugal force. The drum E is the driven member of the clutch. The block B has a boss F, and the drum E a sleeve G encircling this boss. The invention relates to improved means of providing lubrication between the boss and sleeve. Longitudinal recesses H are provided in the driving block, and these recesses carry a non-fluid lubricant K, such as graphite. The lubricant may be in the form of bars or sticks which fit loosely in the recesses of the driving member, or it

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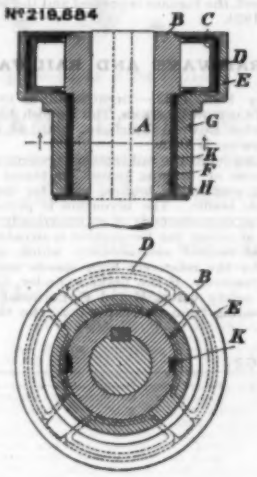

may be in granulated or powder form. As the driving block commences to rotate the lubricant is thrown outwardly by centrifugal force into contact with the inner face of the sleeve G, and provides efficient lubrication until such time as the shoes commence to drive the drum.—*August 7th*, 1924.

219,886. February 5th, 1924.—IMPROVEMENTS IN ELECTRIC JOINTS, Charles James Beaver, of Rangemoor, Crescent-road, Hale, Cheshire, and W. T. Glover and Co., Limited, of Trafford Park, Manchester.

An example of a joint made in an electric cable in accordance with this invention is shown. A is the cable. The stranded conductor B has portions bent outwards radially. C is a sleeve

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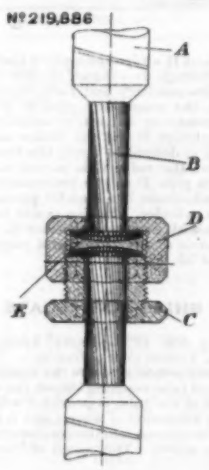

which is threaded externally, D a nut, one end of which is internally threaded. E is a copper disc which is concave on both sides. To assemble the joint the sleeve C and nut D are threaded over the ends of the conductors, and the ends of the strands are then bent out radially. The copper disc is then inserted in the nut, when the nut and sleeve are screwed together.—*August 7th*, 1924.

FURNACES.

220,119. June 22nd, 1923.—IMPROVEMENTS IN AND RELATING TO ENCLOSED METALLURGICAL FURNACES, The British Thomson-Houston Company, Crown House, Aldwych, W.C. 2.

ACCORDING to this invention, greater efficiency and economy than usual is obtained by using the same gas which is necessary for the metallurgical operation as a cooling medium. This is accomplished by establishing a circulation of the gas through the furnace and cooler A after the heating process has been completed, and as a result of this a complete operation can be carried out

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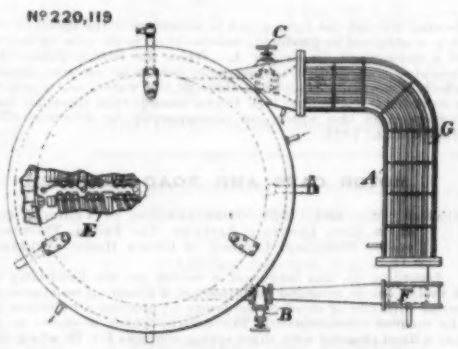


in a large industrial furnace in less than one-fourth of the time usually required. During the period that the work is heated to carry out desired operations, as, for example, the union of metal parts in hydrogen by fusion of metal, the valves B and C are closed to prevent the circulation of the gas through the cooler. After the work of the furnace is completed the supply of current to the resistors E is interrupted. To lower the temperature of

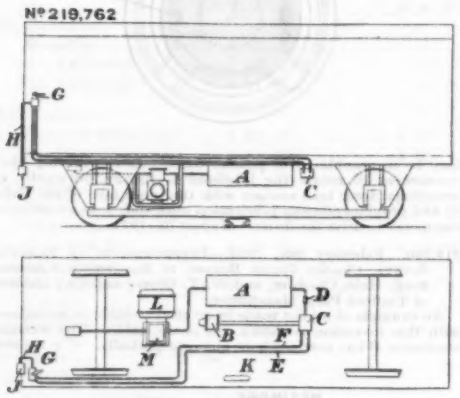
the furnace the valves C and D are opened and a blower or pump F is put into operation. The hydrogen or other selected gas is circulated through the pipes G, where it gives up heat to the cooling fluid. During the cooling or temperature reducing period of the furnace the supply of hydrogen is maintained. When the temperature has been lowered to a desired point the valves C and B are closed, the furnace is opened and the work removed.—*August 14th*, 1924.

TRAMWAYS AND RAILWAYS.

219,762. May 10th, 1923.—IMPROVEMENTS IN VEHICLES FOR USE ON TRACTION SYSTEMS, The English Electric Company and Charles Edward Fairburn, both of Queen's House, 28, Kingsway, W.C. 2.

This invention relates to rail traction systems and particularly to the provision of braking power on trains which are not provided with continuous brakes, such, for instance, as those used for goods traffic. The invention is primarily concerned with braking at opposite ends of an electrically-propelled goods train to that at which the locomotive is situated, so as to give the additional control and security which are desirable to compensate for the relatively high speeds and accelerations. A is the air reservoir, B the brake cylinder, C the emergency valve, D the safety valve, E and F the usual emergency and train pipes leading from the valve C to the brakesman's con-

Nº 219,762



trolling valve G, and H a pipe connecting the valve G to atmospheric pressure through an exhaust muffler J. If it is desired to apply the brakes suddenly and fully, the valve G is moved, so as to connect the emergency pipe E to atmosphere, and this causes the emergency valve C to connect the air reservoir A to the brake cylinder B and the brakes are applied. If, on the other hand, it is desired to apply the brakes gradually and with varying force, the valve G is moved so that it gradually connects the train pipe F to the emergency pipe E, and this causes a gradual admission of air under pressure from the reservoir to the brake cylinder. Motive power is obtained by providing the vehicle with a current collector K, thereby supplying current to an electric motor L driving a compressor or vacuum pump M.—*August 7th*, 1924.

SHIPS AND BOATS.

220,225. January 8th, 1924.—SHIPS' LOGS, M. E. A. Baule, 4, Rue Elisa, Toulon (Var), France.

The inventor proposes to measure the speed of ships by means of a long submerged tube reaching almost the whole length of the vessel. Each end of the tube is provided with a perforated enlargement for the admission of water, and it is claimed that the length of these enlargements eliminates disturbances in the action of the log by the waves. The speed of the current of water

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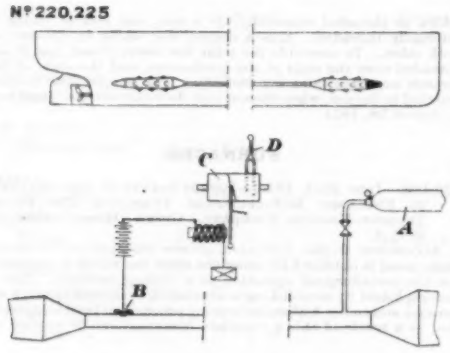

flowing through the tube, which is a measure of the speed of the ship, is obtained by producing bubbles of air in the tube by means of a compressed air supply A. When the bubble passes the insulated contact B it momentarily breaks an electric circuit, which is normally completed through the water, and operates a recorder C. A tuning fork D also records time intervals and the speed of the water can consequently be determined.—*August* 14th, 1924.

MOTOR CARS AND ROAD TRAFFIC.

219,835. May 10th, 1923.—IMPROVEMENTS IN VEHICLES FOR USE ON RAIL TRACTION SYSTEMS, The British Thomson-Houston Company, Limited, of Crown House, Aldwych, W.C. 2.

According to this invention a switch on the head-lamp of a motor car is arranged to introduce a dimming resistance in series with one or more of the lamps to produce a reduction in the current consumption. The switch, which is shown at A, has a fixed element with three spring contacts B C D, which are attached to three terminals as shown. It is also provided with a rotary element with a member E, which can bridge any pair of the fixed contacts. The head-lamp is connected to terminal F, and the ends of a dimming resistance are connected to terminals F and H. The terminal J is connected through a connecting box K in the head-lamp to a battery L, whilst the terminal H is connected through the connecting box M and a junction box N, to a tail lamp O and a side lamp P. With the switch A in the "full" position, the head-lamp R is supplied direct from the battery, the dimming resistance being in circuit with the tail lamp O and the side lamp P. On turning the switch to the off position all the lamps are cut out of circuit. In the "dim" position of the switch, the head-lamp bulb is supplied from the battery through the terminals J and H, the dimming resistance and terminal F, and the tail and side lamps are supplied direct through terminals J and H. Thus the dimming resistance is in series with the head-lamp in the "dim" position but is cut out in the "full" position. It is also to be observed

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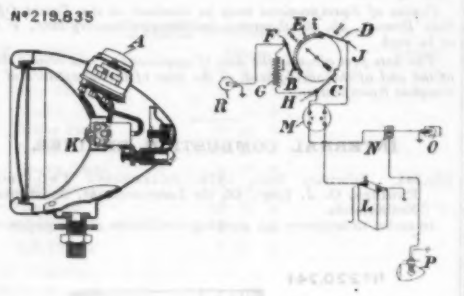

that the dimming resistance is in the circuit of the tail and side-car lamps in the "full" position and is cut out in the "dim" position, but as the value of the dimming resistance is small relative to that of the tail and side-car lamps the filament brightness of these lamps is not appreciably affected. If desired, however, the dimming resistance may be so connected that it is in series with all the lamps in the "dim" position.—*August 7th*, 1924.

MISCELLANEOUS.

219,505. August 3rd, 1923.—EVAPORATORS, J. E. Nyrop, No. 18, Upsalagade, Copenhagen, Denmark.

This invention relates to apparatus for vaporising or drying liquids. As shown in Fig. 1, the liquid is supplied through the tube A, which is rotated so that a fine spray is formed, while air is delivered through the tube B. The passages C C provide

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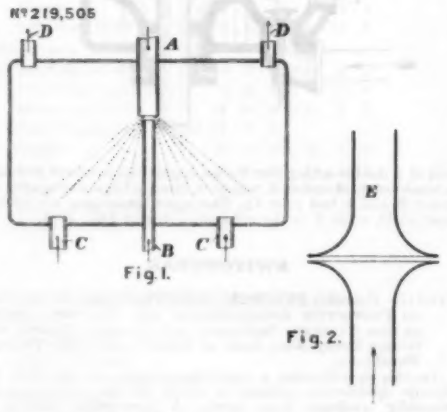

means for the introduction of more air or of vapours which may react on the dried liquid. Moist air outlets are shown at D D. It is suggested that the enclosing chamber may be rotated to spread the jet. As shown in Fig. 2, the rotating liquid tube E is flared out, as is also the air tube, so that the spray and air issue radially.—*July 31st*, 1924.

219,730. April 26th, 1923.—IMPROVEMENTS IN THE MANUFACTURE OF VALVE BOXES OR CASINGS, John Wilson Broadhead, of the Hollies, Elland, York, and Robert Dempster and Sons, Limited, of Rosemount Ironworks, Elland.

According to this invention a valve box casing or cover has raised or sunk surfaces showing in diagrammatic outline, the

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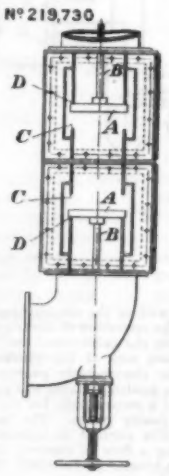

inner construction of the valve box or casing. Attendants or workmen in charge of valves can, therefore, see at a glance how the interior of a valve is constructed. In the example shown the cover has two raised surfaces cast upon it, indicating two disc valves A, provided with stems B and adapted to control one or the other of two seatings C D.—*July 28th*, 1924.

219,766. May 18th, 1923.—MEANS FOR PREVENTING CORROSION IN HYDRAULIC INSTALLATIONS, The English Electric Company and Paul Deriaz, both of Queen's House, 20, Kingsway, W.C. 2.

It is known that in many cases corrosion or pitting is due in part, at least, to an electrolytic effect produced by a closed electric circuit between two different parts f a hydraulic installation, which are in connection with one another and in contact with the same electrolyte. This specification describe a method of overcoming the difficulty. In the drawing A is an elbow attached at one end to the outlet pipe B of a hydraulic turbine and the other end to a draught tube C. The suction

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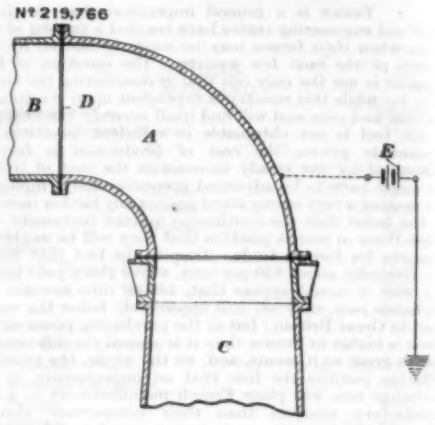

elbow is insulated electrically from the parts B and C by means of insulating material D, placed between the joints. The bolts or rivets are, of course, also insulated. In addition, an appropriate electrical potential may be applied to the elbow by means of a battery E.—*August 7th*, 1924.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

INSTITUTE OF TRANSPORT.—British Empire Exhibition, Wembley. Conference. Papers: "Imperial Communications," by Air Vice-Marshal Sir Sefton Brancker; and "Transportation in relation to the Development of South Africa," by Mr. F. B. Rees. 10.15 a.m.

FRIDAY TO SATURDAY, SEPTEMBER 5TH TO 27TH.

MACHINE TOOL AND ENGINEERING EXHIBITION.—At Olympia. 10.30 a.m. (10 a.m. Saturdays).

SATURDAY, SEPTEMBER 20TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Town Hall, Wallasey. North-Western District meeting. 11 a.m.

TUESDAY, SEPTEMBER 23RD.

INSTITUTE OF MARINE ENGINEERS.—85/88, The Minories, Tower Hill, London, E. 1. "An Engineer's Life in Eastern Oilfields," by Mr. E. B. Seymour Norton. 6.30 p.m.

WEDNESDAY, SEPTEMBER 24TH.

RADIO SOCIETY OF GREAT BRITAIN.—Institution of Electrical Engineers, Savoy-place, Victoria Embankment, London, W.C. 2 Presidential address by Professor W. H. Eccles, D.Sc. 6 p.m.

THURSDAY, SEPTEMBER 25TH.

INSTITUTION OF LOCOMOTIVE ENGINEERS (LONDON).—The Engineers' Club, Coventry-street, London, W. 1. Paper, "The Future of Main Line Electrification on British Railways," by Lieut.-Colonel E. O'Brien. 7 p.m.

SATURDAY, SEPTEMBER 27TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Council Chamber, Town Hall, Gosport. Southern District meeting. 11 a.m.

TUESDAY, SEPTEMBER 30TH.

INSTITUTE OF MARINE ENGINEERS.—85-88, The Minories, Tower Hill, London, E. 1. "Marine Oil Engines, Practical Notes on Bearing Adjustment," by Mr. John Lamb. 6.30 p.m.

THURSDAY AND FRIDAY, OCTOBER 2ND AND 3RD.

INSTITUTION OF MINING ENGINEERS.—British Empire Exhibition, Wembley. Thirty-fifth annual general meeting.

WHITWORTH SCHOLARSHIPS.

THE following awards of Whitworth Scholarships have been made by the Board of Education. They are arranged in order of merit.

Awarded Senior Scholarships of an Annual Value of £250, *Tenable for Two Years.*—William Learmonth, 22, student (late apprentice engineer, Sunderland), Sunderland Technical College; Edward C. Mills, 20, student (late engine fitter, H.M. Dockyard, Devonport), London, Imperial College of Science and Technology.

Awarded Scholarships of an Annual Value of £125, *Tenable for Three Years.*—Ernest F. Powell, 19, engineering apprentice (H.M. Dockyard, Chatham), Chatham, H.M. Dockyard School and Gillingham Technical Institute; Cecil H. Tucker, 20, engine fitter apprentice (H.M. Dockyard, Portsmouth), Portsmouth Municipal College; John Remfry, jun., 20, shipwright apprentice (H.M. Dockyard, Devonport), Plymouth and Devonport Municipal Technical Schools; Arthur R. Staines, 19, engine fitter apprentice (H.M. Dockyard, Chatham), Chatham, H.M. Dockyard School and Gillingham Technical Institute; Stanley W. C. Pack, 19, electrical fitter apprentice (H.M. Dockyard, Portsmouth), Portsmouth, H.M. Dockyard School; Wallace Ford, 19, electrical fitter apprentice (H.M. Dockyard, Portsmouth), Portsmouth, H.M. Dockyard School.